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ANNUAL REPORT OF THE GENERAL ELECTRIC COMPANY.

We print elsewhere in this issue the fourth annual report of the General Electric Company, covering the results of the fiscal year terminating Jan. 31, 1896. The report possesses some interesting features, and perhaps is particularly worthy of attention for the additional light it sheds upon the trade situation which made the recent deal with the company's largest competitor a manifest business necessity. This arrangement will doubtless prove beneficial in many respects, including a reduction in legal expenses, preventing for the time being ruinous competition, and thereby resulting in increased profits. It is probably the misfortune and not the fault of the General Electric Company that its stock has become a speculative football in Wall Street. However often this financial centre is mistaken in its estimates, the course of quotations for a public security is the gauge for the opinion of the financial world. Although the report in substance is apparently complete, the change in form from that in the previous year makes a comparison difficult, and in this respect is not to be commended. The earnings of the year when compared with those of the preceding fiscal year are not particularly encouraging. President Coffin meets this criticism in the opening paragraphs of the official statement, by saying that the actual increase in the output was 30 per cent. greater, while the business done showed but a 10 per cent. improvement. With this fact in mind it is easy to comprehend that the gross earnings of the year, amounting to $13,315,667 (of which $585,609 was derived from royalties), were only $52,056 greater than the reported gross earnings in 1895. Deducting the operating expenses, there remains a net profit for the year of $1,405,426 as compared with $1,811,747 of the previous year, an actual decrease of $406,321. This, however, is offset by the receipt of $421,040 as interest and dividends upon securities owned, an item which has no counterpart in the report of last year, and which, presumably, was then included in gross earnings. This item brings up the total income to $1,826,466. Deducting $437,500, the interest on debentures, the balance becomes $1,388,967, an increase of $41,803 over the previous year. If this balance had been applied to dividends, the full 7 per cent. for the year could have been paid upon the preferred stock, leaving about 3½ per cent. for the common. The question of depreciation is one which is likely to cause considerable trouble for the General Electric Company. While it escaped from the fate which threatened it in 1893 as the result of attempting to act as the financial backer of all sorts of electrical enterprises, the original over-capitalization of its assets has left legacies behind which it is no exaggeration to say will require years of success as a purely manufacturing concern, to wipe out. As the par value of the stock is $34,712,000, $13,917,071 credited to profit and loss represents a deficit of about 40 per cent., or what is generally termed an impairment to capital, to this amount. It is no wonder therefore that Wall Street, while discussing the chances of a decidedly favorable change in the position and earnings of the company, should also have paid some attention to the possibility of a writing off of capital to meet this enormous shrinkage. However this may turn out, and there is no positive indication as to what may be done, the management has endeavored to reduce this item by writing off in the year just ended the amount of $511,321 to profit and loss, thereby reducing the surplus for the year to $877,645. Attention should be called also to the amount of $2,000,000 charged last year to the same account, as a fund with which to provide for the liquidation of the old assets. During the year a shrinkage of $530,152

was taken from this item in addition to the $511,321, leaving about $1,469,847 to provide for a possible shrinkage in the future. It is, however, more pleasing to turn from these dry matters of bookkeeping to such details as the fact that the company borrowed no money during the year, and carried an average cash balance of over $500,000, the cash on hand at the date of the report being $879,685, the accounts payable $428,152, and the accounts receivable $6,584,123, of which over $4,400,000 is a current account with customers. At the same time stress is laid upon the fact that such a large proportion of the $5,479,332 included in securities owned, are carried on the books at the nominal rate of $1 per lot. While, as is shown by the report, $1,359,820 par value of such securities, held at a book valuation of $514,053, were sold for $707,399, it would seem unsafe, judging from the full explicit schedule of the securities given as a supplement to the report, to count very strongly upon a general improvement in this class of assets. The valuation of $8,000,000 placed upon patents and franchises is one of the worst features of the report, and it is safe to say that their value is largely over-estimated. Notwithstanding the arrangement made with the Westinghouse Company, when it is considered that new and important inventions are likely to be brought forth at any time, it is difficult to see how the General Electric, now overcapitalized and in part suffering from over-confidence in the permanent value of its patents, would be able to respond to the demand for additional capital which would thus be created. Although the Schenectady works are apparently placed at a largely fictitious value, the management would doubtless see that this value would be covered in any arrangement made to change the seat of operation, and owing to the benefits to be derived by establishing the various branches in one locality, the probable removal to East Orange is to be looked upon with favor.

MEETING OF THE INSTITUTE.

It is to be regretted that at two consecutive meetings of the Institute sufficient opportunity has not been offered for a discussion of the papers presented. This is doubtless primarily due to the fact that copies of the papers to be read are not previously distributed to all the members. If this were done, it would obviate the necessity of reading the entire contents, and at the same time give ample time for a description, on the part of the author, of the principal ideas he wishes to bring out and experiments he wishes to perform, thus leaving, as has been frequently illustrated, the best part of the evening to a discussion of the features presented before the members. The interesting paper which Prof. Puffer read at the previous meeting was unavoidably lengthened out by adjourning to Columbia University, whereas in the paper of last Wednesday evening, Mr. Moore, instead of carefully explaining the apparatus which he employed, carried the members through the tedious and trying ordeal of listening to an unimportant repetition of the entire contents, besides frequently adding superfluous remarks. It is chiefly for this reason that the meeting adjourned without discussion, although we think that, notwithstanding the lateness of the hour, had the president allowed sufficient time to elapse, in order to overcome the natural indisposition on the part of the members to become awakened, it is safe to say that a discussion would have taken place which would have proved not only interesting to all present, but especially beneficial to the author himself. In reference to the paper, the vibrator which Mr. Moore employs is, in its simplicity and effectiveness, an exceedingly neat conception, but the lighting effects which he obtains by the use of the old and familiar Geissler tube, are, in so far as the experiments demonstrated, no apparent improvement over those which may be produced by other means. When we see a 7½-hp dynamo laboring to operate a number of tubes, the illuminating effect of which is equivalent to some half-dozen incandescent lamps, we are forced to the conclusion that by continuing under the conditions which he now employs, Mr. Moore is not likely to soon revolutionize existing methods. It is far from our intention to disparage the work which he has accomplished, but on the contrary, we wish him, as well as others who are attempting to improve upon present practice, every success. We wish to suggest, however, that should he again be favored with the opportunity to present a second paper before the Institute, touching on the economical aspects of the methods he employs for lighting, he states his authorities for the theoretical statements which he makes.

RÖNTGEN RAYS.

The article by Prof. Lodge, printed elsewhere in this issue, although it contains little that is not already familiar to those who have kept in touch with the subject of Röntgen rays, still presents several new ideas and at the same time gives a brief résumé of the progress thus far made in this field of research. In our issue of March 28, attention was called in these columns to the advisability of repeating the experiment of placing a sensitive plate in an exhausted vacuum tube and exposing it to the direct action of the cathode discharge, an experiment first performed by Prof. J. J. Thomson. Apparently no report has been made to the effect that this has been tried, and attention is again called to the necessity of repeating the experiment by Prof. Lodge. By so placing a plate within a tube that it will be directly acted upon by the cathode rays and another in a second tube placed in such position as to receive the direct action from a secondary source, interesting conclusions could doubtless be drawn from the effects obtained. Prof. Lodge believes that if Röntgen rays are waves at all, transverse waves are to be considered at present the more probable, and that they are most likely of extremely short wave length, a view which is in accordance with the opinion expressed by Prof. Rowland in our columns of last week. As to the source of the rays, Prof. Lodge agrees with the conclusions arrived at in this country, namely, that they start from the surface acted upon by the cathode discharge. He calls attention to the extreme caution with which experiments are performed depending upon the use of insulators, as all bodies become conductors when acted upon by the rays. He does not believe, however, that it has been clearly shown that any difference exists between one metal and another in the rapidity of positive and negative discharges. Although it has been quite conclusively shown that Röntgen rays cannot be produced by other means than by the use of the vacuum tube, yet, considering the diffusive effects of the air at ordinary temperatures and pressures, the experiment which Prof. Lodge suggests of attempting to find whether the rays are emitted from the sun, by exposing a plate under suitable conditions on the top of some high mountain, is apparently worth trying.

The Patent Combination.

The organization of the committee to administer the patent affairs involved in the recent arrangement between the Westinghouse Electric & Manufacturing Company and the General Electric Company, has been completed by the selection as the fifth member Mr. E. B. Thomas, president of the Erie Railroad Company. Mr. Samuel Spencer, president of the Southern Railway, was selected as alternate. The full committee consists of C. A. Coffin and F. P. Fish, representing the General Electric Company's interests, and George Westinghouse, Jr., and Paul D. Cravath, the Westinghouse Company, Mr. E. B. Thomas being the fifth member, and Mr. Samuel Spencer, alternate.

American Society of Mechanical Engineers.

The annual meeting of the American Society of Mechanical Engineers will be held in the parlors of the Southern Hotel, St. Louis, Mo., from May 19 to May 22, 1896. In the list of papers to be presented several will doubtless prove of interest to central-station men. Information regarding the programme may be obtained by addressing Mr. Francis W. Hoadley, secretary's assistant and representative, Southern Hotel, St. Louis, Mo.

Fourth Annual Report of the General Electric Company.

Following is the report of President C. A. Coffin:

SCHENECTADY, N. Y., April 18, 1896.

To the Stockholders of the General Electric Company:

In their last report your directors referred at some length to the liquidation of old assets, and stated that the sum of $2,000,000 had been charged to profit and loss, for the purpose of providing for all shrinkages which could then be anticipated in the liquidation of old matters.

Much has been accomplished in the year just closed in liquidating old and slow assets, and the condition of the assets of like character which still remain on the books of the company is such as to enable your officers to more definitely fix their proper values. Information regarding these matters will be found in the report of the second vice-president, to which particular attention is invited. There have been charged against the $2,000,000 item above referred to the sum of $530,152,16, representing the shrinkages which have accrued from the liquidation so far as completed, leaving $1,469,847.84 still standing to provide for possible shrinkages in the future. It is the belief of your directors that this amount is sufficient to cover all the purposes for which the above sum of $2,000,000 was originally set apart.

The business secured by your company for the fiscal year just closed was less than 10 per cent. greater in value of sales than for the year previous. The *actual* increase in output of factories, based upon capacity of machines and number of articles produced, is more than 30 per cent. greater than for the previous year. While the selling prices as thus shown have been materially reduced, there has been a corresponding curtailment in manufacturing and other expenses and lowering in costs, largely due to improved designs and methods of manufacture.

As will be seen by the statement of profit and loss, the business of the year just closed, including royalties, amounted to		$13,315,667 12
Cost of goods sold, plus legal, patent and general expenses and taxes, was		11,759 857 08
		$1,555,810 04
Less interest on debentures in excess of interest and dividends received	$16,459 40	
Sundry losses	27,178 31	
Depreciation on inventories and consignments	123,204 87	166,842 58
Leaving		1,388,967 46
There is charged off, in writing down factory plants, patents, etc., the sum of		511,321 97
Leaving net		$877,645 49

Sales Department.—Attention is called to the report of the first vice-president, covering the operations of this department. From this report it will be seen that more than 90 per cent. of all the sales for the year were on the basis of cash within 60 days from shipment. The organization of this department is most excellent and effective, and the total expenses of selling and distributing the products of your factories during the past year have been materially less than for any previous year.

Manufacturing and Engineering.—By referring to the report of the third vice-president, in charge of manufacturing, much information will be gained as to that important branch of your business. Your directors are fully alive to the necessity of maintaining in this department the highest possible standard of economy and efficiency and they believe that the results so far attained in this direction are of the greatest value and importance. The achievements of your company in notable installations, involving the highest class of engineering and mechanical skill, have been especially gratifying.

Arrangement with the Westinghouse Company.—Since the close of the fiscal year a contract has been concluded with the Westinghouse Electric & Manufacturing Company, which embodies a recognition of the patents of each company by the other and the right, subject to certain exclusions, to a joint use thereof. An official notification of this contract was given out on March 13, and since then details necessary to make the arrangement effective have been concluded. It is believed that many advantages will be derived from this contract, especially in eliminating much costly patent litigation, and in the important relations of co-operation in engineering and manufacturing methods.

Patent Litigation.—The suits on the Van Depoele electric railway patents have progressed practically to a conclusion. In one case—that against the Elmira & Horseheads Railway Company—the United States Court of Appeals for the Second Circuit has rendered a decision finally sustaining the patent involved in the suit, and giving it a construction which brings within its scope the standard devices universally used for switching electric cars having an overhead trolley. In this suit were also sustained other claims of substantial importance.

In the suit against the Winchester Avenue Railway Company, the Circuit Court of the United States for the Second Circuit has sustained the main Van Depoele trolley patent, giving to it a construction which brings within its scope the standard overhead trolley cars in general use. These decisions are regarded as of great importance, and we believe that the above-named patents having now been established by the courts will prove of substantial value to the company.

Suits on other patents in the railway and lighting field are pending, and are being actively pushed; some of these will come to a hearing during the coming year.

A number of valuable patents have been acquired by the company during the past year.

General Conditions.—The prices of your company's products have undergone excessive shrinkages in the adverse conditions of the past three years, and the securities held by it in local companies which were constructed upon the high prices of the past depreciated in like degree during the panic of 1893 and in the year subsequent thereto. Greatly modified valuations of your various assets have thereby been made necessary from time to time, and much information relating thereto has been brought to your attention in former reports.

It is believed that the necessity of further reduction of aggregate values will not arise, nor is it expected that the market prices of your products can suffer any substantial decline in the early future. The local enterprises in which your company is interested as a creditor or security holder are, as a rule, returning to normal conditions. Many of them give promise of greatly increased prosperity.

Similarly the inventories and other investments of your company are in such shape as to lead your directors to anticipate no shrinkage therein beyond that for which provision has been made. In the mean time the varied applications of electricity are increasing and the output of the company's works should be augmented as a result of the added uses to which electrical apparatus is almost daily being put.

It will be noticed by referring to the profit and loss statement that the revenue derived by your company from interest and dividends for the past year was nearly sufficient to provide for the interest on its outstanding debentures.

By order of the Board of Directors,

C. A. COFFIN, *President.*

REPORT OF THE FIRST VICE-PRESIDENT.

The report of Eugene Griffin, first vice-president, shows that the business of the sales department during the year ending Jan. 31, 1896, amounted to $12,730,058.07. The company has over 10,000 customers, from whom a total of 104,000 separate orders were received, an average of about 350 per day.

Besides its regular supply business, the company sold nearly 12,000 complete machines, having total capacity of about 500,000 horse-power. These figures include over 8800 street car motors and over 90,000 horse-power of railway generators. Nearly 6,000,000 incandescent lamps, over 27,000 meters and other auxiliary apparatus and supplies in proportion were also sold.

Over 93 per cent. of the sales of apparatus and supplies provided for cash payments within 60 days, and only three tenths of 1 per cent. provided for payments in stocks, bonds and exchanged apparatus.

Under the head of "new business" Capt. Griffin refers to the 90-ton electric locomotives supplied to the Baltimore & Ohio Railroad Company, for hauling trains through the Baltimore tunnel, and says their successful operation has removed all doubt as to the possibility of substituting electricity for steam in the heaviest traction work, and offers a complete solution of the tunnel problem on steam roads. The electrical equipment of the Nantasket Beach branch of the New York, New Haven & Hartford Railroad is also referred to. The new problems presented in this enterprise, he says, have been successfully solved.

The report refers briefly to the successful operation of the Lenox Avenue line in New York City, and the Metropolitan Street Railway lines in Washington, as examples of the only commercially successful electric railways in this country operating with conductors in underground conduits. It also refers to the successful operation of the Metropolitan West Side Elevated Railway of Chicago.

The electric power transmission plant at Fresno, Cal., the applica-

tions of multiphase apparatus in coal mining, of multiphase motors to mill work, and the development of a successful electric brake are briefly referred to. The extension and development of the monocyclic system during the year have been marked, the report states. The development of large "rotary converters" for changing alternating to direct currents was brought about by necessity, and a growing business in this field is looked for.

After touching upon the increasing use of electricity in the chemical arts, and the obviously probable increase of the company's business resulting from such new applications, the report closes with the following reference to prices:

"Selling prices are now on a very low scale, but if present minimum prices are maintained, we can, by further economies, increase our net profits to a more satisfactory figure."

MANUFACTURING AND ENGINEERING.

The report of E. W. Rice, Jr., third vice-president, upon manufacturing and engineering during the year, states that the manufacturing costs have continued to decrease, resulting largely from increased economy of manufacture and the best application of engineering methods. The capacity of the company's plants increased at least 25 per cent. during the year. The output, during the year, in round numbers, was 380,000 kilowatts (509,000 horse-power), an increase of 35 per cent. over the business of 1895.

In the engineering department the company has supplied or has on order 60,000 horse-power of apparatus for the conversion of the energy of water power into electricity and its transmission to distant places to be converted into light, heat and mechanical power. Several of these installations, which are operated on the company's three-phase alternating-current system, are named, as are also other notable power and light installations. The demand, in general, the report says, has been for a largely increased size of electrical unit, whether of generator, motor or transformer. A few years ago a 200-hp generator was considered large; during the past year the General Electric Company built several of 1000 horse-power and over.

During the year 92 applications for letters-patents were filed covering all branches of the engineering business, and 91 letters-patent were issued to the company's engineers and assigned by them to the company.

[The statement of the financial operations of the General Electric Company during the year will be found in our financial columns.]

Decision of Conduit Patents.

We notice in the issue of *Selected Corporation Cases* of April 6, that in the suit of the National Conduit Manufacturing Company against the Connecticut Pipe Manufacturing Company, the decision of Judge Townsend simply refers to an injunction against the Connecticut Pipe Company, which decision is based on contract relations existing between the National Company and E. H. Phipps, at the time that Phipps sold out to the National Company. The decision does not touch on the validity of the patent at all, but simply holds that Phipps, having sold out to the National Company, cannot at the time seek to prove the patent which he sold it invalid. Thus the statement which appeared in our last issue that this gives the National Company full control of the field, cannot be so construed from the decision.

A Method of Determining the Unit of Magnetism.

Owing to an oversight, an unrevised article appeared in the issue of April 18, page 426, under the above title. The French script was omitted, and the following obvious corrections should be made. Instead of reading

$$\mu = \frac{B}{M} \text{ and } C\ T = \frac{L\,M}{4\,\pi}.$$

read

$$\mu = \frac{B}{H} \text{ and } C\ T = \frac{L\,H}{4\,\pi}.$$

Also in the sixth line below the last equation read: "the current units times the turns required per 4π units length."

Reflection of Röntgen Rays.

The experiments performed by Prof. Ogden N. Rood of Columbia University on the reflection of Röntgen rays from a platinum surface were accepted without question by the members of the National Academy of Science at their meeting in Washington last week.

The Chemical Theory of Lead Accumulators.

BY MAURICE BARNETT.

(*Continued from page 456.*)

This view was taken by Gladstone and Tribe in 1883 and has been held to be correct ever since. It is, in fact, forced upon us because the direct sulphation of PbO_2 as an electrolytic reaction is contrary to the laws of electrolysis. To explain the reaction we have therefore to assume, first, an electrolytic action contributing to the E. M. F. of the cell which ends with the production of PbO, and second, a secondary action attended with production of heat resulting in the formation of $PbSO_4$. Just what part each of these reactions plays in the conversion of the positive electrode into sulphate is a mooted question to this day.

As in the case of the negative electrode, not more than half the active material of the positives is converted into sulphate during normal discharge. When such cells are overdischarged the balance of the PbO_2 is acted on and the greater part converted into sulphate. These two reactions are exemplified in equations (11) and (12), the latter showing the action taking place when the cells are "sulphated."

$$H_2 + 2\,PbO_2 + H_2SO_4 = PbSO_4 + PbO_2 + 2H_2O \qquad (11)$$

$$PbO_2 + PbSO_4 + H_2SO_4 + H_2 = 2PbSO_4 + 2H_2O \qquad (12)$$

In a preceding paragraph it was stated that there was some reason to believe in the formation of basic sulphates at the positive electrode. Under this view each molecule of $PbSO_4$, as it forms, combines with a molecule of PbO_2 to form the compound $PbSO_4 . PbO_2$.

With such a compound existing it is easy to see how the active matter will retain its conductivity all through the normal discharge, ensuring the reversal of the cell during subsequent charging. While this view cannot be proved owing to the difficulties encountered in making qualitative and quantitative chemical analysis of lead compounds, owing also to the unstable nature of these compounds when isolated, there is nevertheless grounds for the belief that they do exist. In the first place it is a fact that all lead salts form basic compounds, and indeed enter into these with the greatest ease. Second, Dr. Frankland isolated a compound which he believed to be the basic sulphate in question. Third, during one of Prof. Ayrton's experiments, some of the material which fell out of a positive plate which had been charged down to 1.6 volts was found on analysis to correspond in constitution with the basic sulphate $PbSO_4 . PbO_2$. Lastly, when the PbO_2 existing uncombined in this mass was dissolved out by HNO_3 only white sulphate should have been left, if no basic sulphate were present; but this white sulphate was only obtained on treating this residue with boiling nitric acid. This certainly points to the possibility of the existence of a basic sulphate at the positive electrode.

Thus far we have concerned ourselves with discharge reactions. The reactions of charge are practically the reverse of these. The change that the negative electrode undergoes is easy to follow. Under the influence of the charging current H_2SO_4 is decomposed. The hydrogen liberated at the negative electrode reduces the lead sulphate existing there to metallic lead and regenerates H_2SO_4, which re-enters the electrolyte. This change can be denoted by the following equation:

$$PbSO_4 + H_2 = Pb + H_2SO_4. \qquad (13)$$

As the charging proceeds and more and more of the $PbSO_4$ is converted into spongy lead, free hydrogen will be evolved in volume depending on the density of the charging current.

What takes place at the positive electrode is believed to be as follows: The sulphion (SO_4) first separated combines with the $PbSo_4$ to form a persulphate thus:

$$PbSO_4 + SO_4 = Pb\,(SO_4)_2 \qquad (14)$$

This is then decomposed by the water of the electrolyte with formation of PbO_2 and the regeneration of H_2SO_4 as shown by equation (15).

$$Pb\,(SO_4)_2 + 2\,(H_2O) = PbO_2 + 2\,(H_2SO_4) \qquad (15)$$

At first all the sulphion (SO_4), as fast as it forms, combines with the $PbSO_4$ to form persulphate, which then undergoes decomposition as shown above. When the greater part of $PbSo_4$ has been converted into PbO_2 the sulphion (SO_4) combines now with the H_2SO_4 around the positive electrode, forming persulphuric acid $H_2\,(SO_4)_2$. As this, however, is not a stable compound it breaks up into sulphuric acid and oxygen thus:

$$H_2SO_4 + SO = H_2\,(SO_4)_2 \qquad (16)$$

$$H_2\,(SO_4)_2 + H_2O = 2H_2SO + O \qquad (17)$$

It is this oxygen which we see coming off in such large quantities at the end of the charging period. That hydrogen peroxide is found in the electrolyte arises from the circumstance that a small amount of persulphuric acid diffuses through the solution and undergoes decomposition with production of heat. The chemical reaction is expressed as follows:

$$H_2(SO_4)_2 + 2\,H_2O = 2\,H_2SO_4 + H_2O_2 \qquad (18)$$

This H_2O_2 is finally decomposed into oxygen and water.

$$H_2O_2 = H_2O + O. \qquad (19)$$

The above explanation of the part played by the persulphuric acid in the reactions taking place during the charging of lead accumulators is based on the researches of Prof. Marshall into the nature of persulphuric acid and the formation of its compounds. That persulphuric acid is formed in large quantity during charging is proved directly by analysis and indirectly by the temperature changes occurring during this period. For the first two thirds of the charge the temperature of the cell is rather constant; after that it goes on increasing right up to the end of this period. This is what we should expect, for during the first two thirds of the charge the amount in the electrolyte is constant; but from this point on it increases until a point is reached where the persulphuric acid is decomposed as fast as it is formed. The connection between these phenomena is very striking.

Now, if the reactions taking place during charging were purely of an electrolytic nature, there would be no evolution of heat, save that resulting from the resistance of the electrolyte. But the experiments of Ayrton and Lamb have demonstrated that after allowing for rise of temperature, due to resistance, a very large amount of heat is left to be accounted for, *equivalent to 17 per cent. of the total energy put into the cell.* The most natural way to account for this heat is as a product of the decomposition of persulphuric acid. This compound, being of the exothermic order, absorbs energy during its formation, and yields this as heat during its decomposition.

From the statement made that the chemical reactions of discharge are practically the reverse of those of charge it might be inferred that the current furnished by an accumulator during discharge would be the counterpart of that used to charge it. Such, however, is not the case, the E. M. F. of the discharging being considerably below that of the charging current.

The curve of E. M. F. of the chloride accumulator is, at the start, somewhat over 2.1 volts, and this rises uniformly during the charge, the upward tendency being most marked at the close. The curve of E. M. F. at the beginning of discharge is about .35 of a volt below that of the charging current, and falls gradually during the first 10 hours of discharge and then very abruptly during the last two.

To explain the high E. M. F. noticeable on charging two causes have been assigned. Messrs. Gladstone and Hibbert ascribe it to the increase of H_2SO around the electrodes due to the decomposition of lead sulphate, while Mr. Robertson and others are inclined to believe that it is due to the presence of the persulphuric acid so largely produced during charging. In criticising the view of Gladstone and Hibbert Mr. Wade says: "This theory, while extremely plausible, is hardly consistent with the whole facts of the case. If it were correct, the local weakening of the acid on discharge ought to be equally marked provided the current in both cases is the same, and the accompanying E. M. F. as much too low as the other is too high. Instead of this it will always be found that throughout the greater part of the discharge the E. M. F. is but slightly below what is required to correspond to the strength of acid indicated by a hydrometer inserted in the main body of the liquid." The facts, moreover, that diffusion takes place more rapidly when the cell is fully charged and that the gas battery, possessing insoluble electrodes, likewise shows a high E. M. F. at end of charging period, disprove the view advanced by Gladstone and Hibbert.

The view of Mr. G. H. Robertson that the high E. M. F. in question is due to the persulphuric acid in the solution is decidedly more plausible, as it affords an explanation why, in the gas battery, the E. M. F. is above that established by the tension between oxygen and hydrogen. Although it is admittedly difficult to prove the relation between the high E. M. F. of charge and the presence of persulphuric acid in the solution, temperature changes point to the formation and decomposition of some such exothermic compound.

Although Messrs. Gladstone and Hibbert have not made good their stand with regard to the cause of the high E. M. F. of charge, the phenomena of the loss of E. M. F. following a heavy discharge and the recovery of this on standing may be explained by the strengthening of the acid at the electrodes; for it is evident that during a heavy discharge sulphation will take place rapidly, and the H_2SO_4 distributed through the mass of the active material would be largely withdrawn from the electrolyte before it could be replaced by diffusion. Naturally under these circumstances the E. M. F. of the cell would fall; as soon though as sufficient time had elapsed for the cell to regain its normal condition so far as the penetration of the electrolyte into the pores of the active material is concerned, a higher E. M. F. would follow.

That the E. M. F. falls so very rapidly toward the end of the discharge is probably due to the fact that when sulphation has reached a certain stage, say when half the lead is converted into sulphate, further sulphation is attended with the production of the normal white sulphate; at this stage the diffusion of the persulphuric acid left over as a residuum from the last charge and its decomposition with formation of H_2O_2 leads to the formation of PbO_2 at the negative electrode. The production of this compound at this unexpected point explains the rapid drop of E. M. F. noticed at the close of the discharging period.

Notes on General Electric Alternating-Current Machinery—V.

Of the many topics bearing upon the best methods of alternating-current practice, none, perhaps, has brought forth more discussion than the question of frequency, and as the conclusions arrived at by different writers have been more or less conflicting, it will prove of interest, we trust, to learn why the standard of 60 cycles per second has been adopted by the General Electric Company. The tendency, and in fact, the general practice abroad has resulted in the employment of frequencies in this neighborhood, showing that whatever may be the advantages of very high frequencies, those to be gained by the use of lower are paramount.

Frequency.—All of the old single-phase generators were designed for 125 cycles per second, but the latest types are designed for 60 cycles, as has been previously stated.

There is no reason why motors cannot be operated on circuits of any frequency, but in order to get them comparatively small, and at the same time adapted to low speeds, frequencies lower than 125 must be adopted.

The drop in the line is another factor of great importance. The reactance voltage, that is the drop due to self-induction of the line, is directly proportional to the frequency, and consequently if we have twice the frequency we get twice the reactive drop. The total drop, that is the impedance drop, is the square root of the square of the ohmic drop plus the square of the reactive drop, and consequently the total drop in the line is greatly increased as the reactive drop increases. As an example we will consider a No. 0000 B. & S. wire, which has an ohmic resistance of .26 ohms per mile. The reactance at 60 cycles is .65 ohms per mile, and the reactance at 125 cycles is 1.34 ohms, consequently the impedance of the line at 60 cycles is .7 ohm, and at 125 cycles 1.37 ohms. With a power factor as high as 95 per cent. this gives an apparent resistance to the line at 60 cycles of .44 ohms and at 125 cycles .66 ohms, or the apparent resistance is increased 50 per cent., with about 100 per cent. increase in frequency. It is to be noticed that at 60 cycles per second the reactance is about two and one half times as large as the resistance for this particular wire; in sizes of wire most commonly used, that is, from No. 1 to No. 6, at 60 cycles, the reactance is very small, and in most cases practically negligible, while still very considerable at 125 cycles.

From what has just been said it would appear that low frequencies are preferable, but transformers used on low-frequency circuits are necessarily larger for the same output than those required when higher frequencies are employed. Consequently a mean between the two must be chosen, the higher frequencies being avoided, owing to the greater drop in the line and the necessarily high speed of generators and motors, while it is practically impossible to operate incandescent lights below 25 to 30 cycles per second, and arc lights below 40 to 45 cycles, owing to the perceptible flickering. It is chiefly for these reasons that the General Electric Company has adopted 60 cycles as a standard.

In special cases, as for instance, in transforming alternating currents to continuous currents, it is advisable to use still lower frequencies, as otherwise the peripheral speed and the number of poles of the rotary transformers have to be high. The rotary transformers operating the plant of the Pittsburg Reduction Company are running at 25 cycles, and the Portland and Lowell transformers at 30 cycles. For very large units it might be advantageous to go even still lower.

Alternating-Current Transformers.—Constant improvements have taken place in the manufacture of alternating-current transformers built by the General Electric Company, and the old forms of type B. & E. transformers have been replaced by the type of more modern design, and in the latter constant improvements have been made without change in appearance and size by the use of better iron and consequent increase in efficiency, until at present the iron used in these transformers has a hysteretic coefficient as low as .0025, while in the older types frequently two and three times this quantity were unavoidable.

The result of this reduced core loss has been an increased efficiency, which shows up especially in an increased all-day efficiency.

The type F transformer is shown in Fig. 46, and is probably well known to the reader. It consists of primary and secondary coils laid close together, interwound in the larger sizes, and surrounded by a divided magnetic circuit giving the least magnetic length for a given magnetic cross-section The losses in an alternating-current transformer consist of the $C R$ loss in the copper of the primary and secondary coils, and the hysteresis loss in the iron. Of these the latter is by far the more important factor in the all-day efficiency of the system. since it takes place continuously, whether the transformer is loaded or not, while the loss in the copper is noticeable only under load and practically disappears when the transformer is but lightly loaded. It is therefore of the greatest importance to keep the hysteresis loss in the transformer as low as possible. For instance, if in a transformer having an efficiency of 96 per cent. at full load the C^2R loss being 1 per cent. and the hysteresis loss 3 per cent., we assume that the full load is on during two hours of each day, running at no load the remaining 22 hours, it follows that the total loss in the transformer for the two hours will be 4 per cent. of the rated output, and that for the remaining 22 hours 3 per cent., giving a total of $\frac{4 \times 2 + 3 \times 22}{2} = 37$ per cent. of the true output, which is an all-day efficiency of 63 per cent. If now the transformer be redesigned, so as to give a C^2R loss of 2 per cent. and a hysteresis loss of but 2 per cent., then with the same full load efficiency of 96 per cent., the all-day loss would be under the previous condition of load, $\frac{4 \times 2 + 2 \times 22}{2} = 26$ per cent., that is the all-day efficiency would be 74 per cent., which is considerably higher than in the first case.

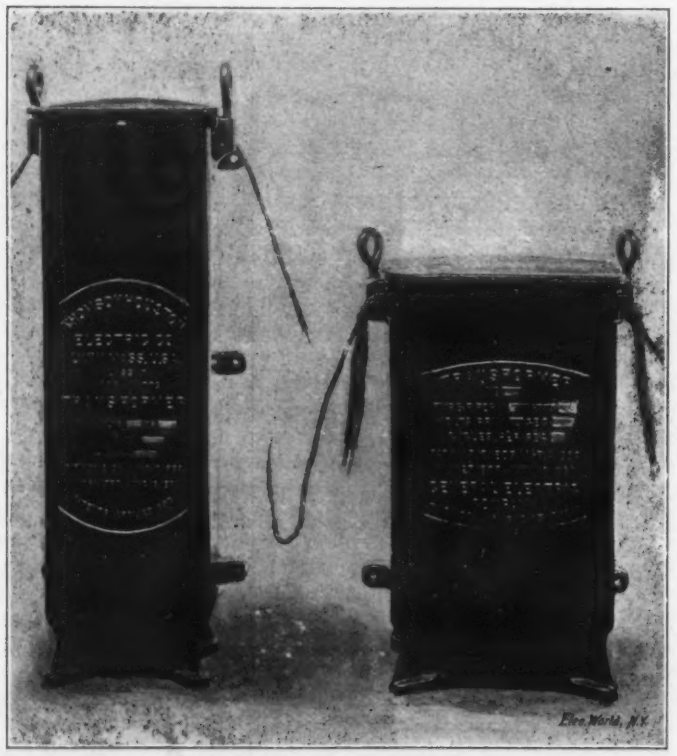


Fig. 46.

In reality, transformers used for lighting very seldom run at full load, and most of the time operate practically at no load. This shows the exceeding importance of having hysteresis loss as small as possible, while the C^2R loss which takes place only under load, that is where the efficiency is high, is of less importance. With the advent of the new low-frequency work at 60 cycles, it was found desirable to design a new line of transformers, giving the same high efficiency at 60 cycles as the type F transformers give at 135 cycles. While the type F transformers can be used at 60 cycles as

Fig. 47.

well as at 125 cycles, the efficiency, and especially the all-day efficiency, is necessarily lower at the lower frequency, and, therefore, for high economy work a special line of low-frequency transformers became desirable. These have been called type G transformers, and have essentially the same features as those of type F, except that the secondary voltages of 115 and 230 volts, the latter being designed for the three-wire system, have been used, corresponding to a ratio of transformation of 1 to 9 or multiples thereof, while in the type F transformers the ratio of transformation of 1 to 10 is used with secondary voltages of 52 and 104. The higher secondary voltage in the type G transformer is to be preferred, since in low-frequency systems it is more economical, and at the same time offers the desirable opportunity of employing secondary mains, utilizing the increased secondary voltage with the attendant increased efficiency. For this reason the same secondary voltage was adopted as that commonly used in continuous low-tension distributing systems.

The exciting current of the transformers, that is, the current passing through the primary coil at no load, frequently but erroneously called the leakage current, is of comparatively small importance for the efficiency of operation, since it is essentially a lagging or idle current and does not represent power consumed. This means that the current reaches its maximum when the volts have decreased, and that the maximum value of the volts occur at the moment when the current is still very small, so that the product of volts and amperes or the total power is considerably less than the product of average volts and average amperes. That part of the exciting current which represents energy, is, however, of great importance. Since it is the energy consumed due to hysteresis it is called the hysteretic energy current, or in other words, in a transformer having a 2 per cent. hysteresis loss the energy part of the exciting current is 2 per cent. while the total exciting current may be 3 or 4 per cent., or even more according to the construction of the transformer.

Type F and type G transformers are built in sizes from 300 volts up to 30,000 volts, and from 6 lights to 600 lights. In the larger sizes the primary and secondary coils are interwound with each other so as to give low self-induction, and thereby close regulation, or a small drop of voltage from no load to full load. If the distance between the primary and secondary coils in a transformer is considerable, or the coils are thick, a large percentage of the magnetic flux passes between the coils when the transformer is loaded, owing to the counter magneto-motive force due to the secondary coil. The result is therefore that if the total magnetic flux passes around the secondary coil when the latter becomes loaded the voltage drops off,

To avoid this the primary and secondary coils are brought very close together, so as to leave no room for magnetic flux to pass between them. All the transformers are tested for insulation at a voltage many times exceeding their rated voltage.

The transformers of type F and type G are mounted in cast-iron boxes which can be filled with oil or they may be used without oil.

Large transformers of from 30 kw to about 800-kw output are usually of the air-blast type; that is, both the copper and the iron are thoroughly separated and an air blast produced by a small blower driven by a motor is blown through the passage between the coils as well as the iron. Such an air-blast transformer is shown in Fig. 47. The general type is the same as in the F and G transformers, representing the transformer with external exciting magnetic circuit. The coils stand vertically and consist of a large number of small primary and secondary coils alternating with each other and having air spaces for artificial cooling left between them. The iron is not built up solid, but numerous spaces are left as ventilating ducts. In some of these transformers instead of air a flow of oil is used for cooling and, the whole transformer being emersed in an oil tank, the construction being in other respects the same as in the air-blast type, the oil merely replacing the air for carrying off the heat. Such transformers have been built and are in operation in sizes up to 830 kilowatts and potential up to 12,000 volts. The efficiency of these large transformers is extremely high, reaching 98.3 per cent. in the 830-kw oil-cooled transformer built for the carborundum plant at Niagara Falls and operating at 25 cycles. This transformer is also of interest inasmuch as its magnetic circuit probably represents the largest alternating magnetic flux ever produced, being over 42,000,000 lines.

Further Progress in Radiography.*

BY PROF. OLIVER LODGE, F. R. S.

The applications to surgery and anatomy are growing so important and interesting that they have some tendency to delay progress in the direction of a better understanding of the physical nature of the Röntgen rays. The focus-tubes now in the market are able to stand as much power as can be applied to them by an induction coil with make-and-break. Alternating currents as exciters are unsuitable; a quick, sharp break is much the best. Leyden jars are quite unnecessary. A low-resistance primary, excited by two or three storage cells and a break under alcohol, acting on a large secondary coil, are the means which I have found best for exciting the tubes. A well-exhausted tube can stand for hours discharges which are on the verge of leaping across its terminals outside the glass, and can keep quite cool all the time, although the primary contact-breaker may get partly melted. The vacuum improves in action, and ultimately gets too good, so that the discharge occurs altogether outside the bulb. In that case the flame of a Bunsen suffices to liberate condensed gases from the glass, and gives the bulb a new period of activity. Rays so obtained are very penetrating, and make such bodies as potassium-platino-cyanide and calcium-tungstate fluoresce powerfully. These two substances are the best I have yet seen, and the second is much the cheaper, even if the former is the better, as I incline to think it is. Neither should be powdered, but should be thrown down in minute crystals, and these, when dry, should be spread on a layer of clear varnish painted over either tracing-cloth or glass. Several such layers of crystals superposed give a good screen, which, mounted as the base of a box with two eyeholes at the distance of distinct vision in the dim light, enables the effect of even feeble Röntgen rays to be readily seen. Of course, actual light is to be excluded by two or three thicknesses of photographic black paper or otherwise. Armed with such a spy tube, and having accustomed the eye to a dark room for some time, the screen can be seen to fluoresce under the action of rays which have penetrated considerably more than a foot thickness of solid pitch-pine. The rays which have penetrated a person's chest also have the power of exciting vivid fluorescence. Indeed, under favorable conditions, the rays which have been through one person can be sent through another, and their effect can still be seen after that. Of course, clothes make no practical difference. It is rather less easy to see through a head than through a chest, but it is quite easy enough to see through every part of the body when things are working well, but in no case have I as yet been able satisfactorily to perceive any detail by this method of viewing. Whether it be merely that the light is too dim for discrimination, though apparently rather bright, or whether it be that these very penetrating rays make less distinction than ordinary rays between bone and other less dense material, I am not sure. Possibly there is truth in both these obvious suggestions. It would not be easy to read a page no more strongly illuminated than is the fluorescent screen after the rays exciting it have penetrated the trunk, and perhaps the absence of detail is thus sufficiently explained; but I have been several times forced to surmise that just as the original Lenard rays are easily stopped by a few inches of air and have feeble penetrating power, so Röntgen rays may be of two or more kinds, perhaps differing in something of the fashion that violet light differs from red; and that, whereas close to the source we get Röntgen rays only, *i. e.*, those which descriminate most clearly, and throw therefore the most instructive shadows, so after great obstruction like a human body, only the most penetrating quality of ray gets through. And under these circumstances the interposition of the palm of one's hand scarcely adds to the shadow, nor do the bones of the palm make their appearance in so prominent a manner as one might expect from the general brightness. Against this, however, is to be recorded the fact that I have taken a photograph of a spine to discover the nature of the damage to a vertebra in a patent, and the details of the processes of the vertebræ come out well. Also I have taken a hand with rays which have come through six inches of pitch-pine, and the bones, though a little blurred, are not bad.

Naturally the body radiographs are not easy to read, except by a skilled anatomist after some practice, because the aspect of bones which are semi-transparent, and are all projected together upon a flat surface, is by no means a usual aspect, indeed is quite a novel one, and requires to be learned. A study of the skeleton, and some skill in drawing, are necessary in order to disentangle the superposed impressions. But the impressions themselves are not indistinct. The internal organs also appear. Comparing this method of investigation with the stethoscopic method, it cannot be thought that the stethoscope is the easier. To a novice both would seem equally puzzling, and both require skill and experience.

Foreign metallic bodies in the trunk, such as a Murphy button used by surgeons for joining cut intestines, are, of course, easily radiographed. The other day I got a good impression of one of these in an adult, with only 10 minutes' exposure of the plate.

But here again some evidence of possible physical interest occurs. The outline of the button, naturally at some distance from the flat, is not sharp. Its shape is quite visible, but its outline is blurred. Of course it is enlarged by the cone of rays, and its position between plate and source could be estimated exactly by its size, if only its outlines were sharp. Possibly the blurring is only due to internal movements in the body; the intestines are known to be very movable; but if, as Lenard said, opacity is in the nature of turbidity, the whole body glowing as if it were like faintly-ground glass under the action of the rays, which is just what it looks like through the described spy-tube, then this slight haziness of outline may be considered as physically explained.

A coin laid upon each plate serves as a handy label and a guide in developing. It may be worth remarking that a threepenny bit placed on top of a shilling comes out readily on a plate, and that one can "see" through several thicknesses of sheet iron such as tinplate.

As to the photographic plates used, I have found that only plates by the best makers are of any use. A cheap packet, in which some of the plates may have been already partially fogged, is utterly unsatisfactory. Hitherto Edwards' isochromatic plates have done best for me, though Marion's rapid, and probably any thoroughly good makers are equally good; and I do not now fancy that the isochromatic property is an essential help. Either the hydroquinone or the pyrogallate developers are perfectly satisfactory, but my assistant usually prefers the hydroquinone. In developing the plates it must be remembered that the penetrating power of the rays has enabled them to operate equally right through the film, and not chiefly on the surface; hence, development may be safely pushed pretty far. This fact may have given rise to the opinion that the films are acted on from the glass outward, instead of from the surface of the films inward, as in the case of light. At present I am not by any means convinced of the truth of this opinion.

It would, however, be very remarkable if that interesting experiment of Prof. J. J. Thomson's should be confirmed, viz., that the cathode rays themselves inside a vacuum had no power of exciting a photographic plate. From their violent action on glass it would seem more likely that their action, though admittedly indirect, must

* From the *London Electrician*, April 10, 1896.

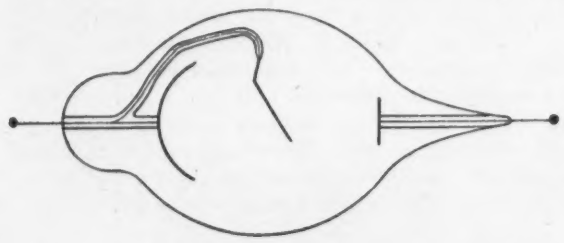
nevertheless be strong, perhaps strong enough to undo and mask their initial effect. At any rate the experiment needs repeating.

As to the source of the rays, I, like others, have made many experiments, and the results are definite enough. When the rays are from the cathode, inside the vacuum, and impinge first on a glass surface, then that surface is the source. It is not as if the cathode rays penetrated the glass and proceeded on their path; it is not as if the glass surface were a wave front, from every point of which a ray proceeded normally; the glass radiates X-rays just as a red-hot surface radiates light. From every point a cone of rays starts in all directions, and there is no mutual interference in the lateral directions, as there would be between a number of similar sources all in the same phase. Every point of the glass radiates independently like a hot surface, in fact. The best experiments of this kind were those in which I used a magnet to deflect the cathode rays on to any chosen spot or patch of the glass, and then took shadow photographs through slits and holes placed at a measured distance. The shadows of wires at a distance from the plates, taken through a narrow slit at some distance from the wire, show that if the X-radiation consists of waves at all, those waves must be very small. There has been nothing, as yet, to discriminate between longitudinal and transverse oscillations. Transverse must be considered as the most probable at present but then it is not certain that they are waves at all. If waves, they must be very small ones; and the question whether they are transverse or longitudinal is almost a minor consideration if it should turn out that the wave-length is comparable to the size of molecules. The interest and importance of such an instrument of investigation as radiation with that size of wave, whereby indirectly molecules themselves would hereafter be rendered diffractionally visible, are immense.

When the cathode rays do not first strike the glass, but first strike a piece of metal enclosed in the bulb, then its behavior depends largely on what it is connected to. My experiments on this point are not complete, but this much is certain, that if the bombarded piece of metal is attached to the cathode, so that it is unable to receive any electrical charges from the cathode stream, then it either declines to act as a source of rays at all, or else emits a radiation of the most feeble kind, which can without difficulty be attributed to a secondary cause. But on the other hand, if the bombarded disc be connected to the anode, so as to be able to receive the negative charges of the cathode stream, then it acts as a most vigorous source. In a low state of vacuum it will indeed get hot and radiate light, but in a high vacuum every part of the bulb keeps perfectly cool, and the whole energy supplied seems to pass off in Röntgen rays.

The following experiment is worth quoting at greater length:

A bulb like this with concave electrode, having at its centre a rather thick aluminum plate connected to it metallically (wires pro-



Röntgen Ray Experiment.

tected by glass), and beyond in its shadow the other electrode, was excited either with the cup as cathode or with the cup as anode, and pinhole photographs were taken simultaneously from various points of view, and at measured distances. A glass plate was subsequently put in the position of each of the sensitive plates, and the appearance of the tube as seen through the "pinholes" (which were ¼ inch diameter), by an eye roving about, were drawn in ink upon the glass. The eye-picture thus obtained was afterward compared with the developed images, and the sources of the radiation thus clearly observed.

When the small, flat disc was cathode, every part of the complicated anode appeared strongly and quickly on the plate, especially the tilted and first bombarded portion on a plate placed above the tube. The cathode disc itself did not show at all. On a plate placed below the bulb the anode cup appeared strong, but the tilted disc did not appear. On the other hand it threw a sharp, faint shadow *of the hole*, showing that its focus spot acted as a feeble point source, by reason of a few rays reflected back onto it from the cup.

When the current was *reversed*, the small disc anode showed faintly, being excited by rays which had penetrated the interposed tilted disc, but again the cathode hardly showed at all, not even the tilted portion on a plate placed below the bulb. By giving a very long exposure (two hours) some impressions were obtained, about equal to that from the shaded anode disc; but, of course, if the tilted plate had been under these circumstances an anode, it is well known that a few minutes would have sufficed to show it strong upon the plate beneath.

Hence undoubtedly the X-rays do not start from cathode or from anything attached to the cathode, but do start from a surface upon which the cathode rays strike; whether it be an actual anode or only an "anti-cathodic" surface. Best, however, if it be an actual anode. I suggested the term "anode-rays," therefore, while Prof. S. P. Thompson prefers the term "anti-cathodic rays;" but probably the term used by Röntgen is still the best at present.

When the glass walls, instead of receiving cathode rays, are pierced only by the true Röntgen rays from the disc in the middle, no evidence is afforded by my photographs that the glass under these circumstances acts as a source. It is well that it does not, for its only effect would be a blurring one. With focus tubes the glass phosphoresces under the action of the anode or X-rays, as anything else would phosphoresce, but its phosphorescence is not of the least use. It is a sign that the tube is working well and that the rays are powerful, but if by reason of fatigue the glass ceases to phosphoresce strongly, the fact constitutes not the slightest detriment. Not even when the glass itself is the first bombarded thing, and therefore itself the source of the Röntgen rays, does its fatigue make any difference. The fatigued portion of glass *looks* dim and unsatisfactory, while if by means of a magnet the rays are drawn aside from the fatigued patch on to a fresh portion of glass, the fresh portion *looks* bright and active; but the only radiographic result is that the source has shifted in *position*, as can be seen well enough by the shadow-parallax of suitably disposed objects on a fluorescent screen; but no difference in *brightness* occurs. The fresh piece of glass glows brightly and emits much more *light*; but it emits no more Röntgen rays than the fatigued portion. I emphasize this statement because the contrary has several times been asserted.

The phosphorescence of the glass bulb is handy as an index, but it has no further advantage. The quality of the glass is doubtless of some importance, the lighter and thinner the better, one would suppose; and I doubt if *very much* advantage will be gained by replacing it with aluminum. I must say, however, that tungstate of calcium seems to me notably opaque to Röntgen rays, and hence a non-fluorescent substance, or a less fluorescent substance than glass, may be really better for the walls of the tube. I anticipate that the use of uranium or other such glass would be a step in the wrong direction.

All the observations of the discoverer have been confirmed by subsequent experiment, and the only additions that I am aware of to the list given by him are:

First: The focus-tube: which is an old pattern of Mr. Crookes merely more highly exhausted. I first saw it at work in Prof. Carey Foster's laboratory at University College, London, last January, and that particular tube still gives about the best defined results possible.

Second: The use of potassium instead of barium-platino-cyanide, or more recently the use of calcium-tungstate, as the fluorescent screen. Mr. Sydney Jackson, of King's College, seems to have done excellent and most useful work in this entire subject of fluorescence, as well as in helping every one to acquire good and well-made focus-tubes by getting them put upon the market in a thoroughly well-exhausted condition.

Third: The discovery of J. J. Thomson that the rays make insulators conduct.

It is sometimes spoken of as new that the rays discharge electrified bodies, but Lenard observed that in 1894. What had not been previously discovered was the reason why they do this. Many observations, more or less fanciful as I think, have been made as to whether positively or negatively charged bodies are discharged most rapidly; any such observation, to be dependable, requires extreme precaution, even if there were not the complication that nothing can be depended on to insulate when exposed to the stream of rays.

There is here evidently a large field for investigation, but any new results should be received with extreme caution, inasmuch as experiments on electostatic discharge are open to such a variety of disturbing causes at the best of times.

It may be of interest to state that Prof. J. J. Thomson's dis-

covery that the known discharging power of these rays for both positive and negative electricity is to be explained by the fact that they render insulators conductive, has been verified in my laboratory for one or two substances; but any differences between positive and negative discharge, and any difference between one kind of metal and another, remain in my judgment seriously open to doubt.

Another fact may as well be noted, viz., that platinum foil kept white hot by an electric current has practically the same degree of opacity as a cold piece. Five pieces cut from the same sheet were compared simultaneously; they were of different breadths and had the same current flowing through most of them, so that one was white-hot and one was cold, and the others were at intermediate temperatures, but there was no appreciable difference in their transparency. This, of course, tends in the usual direction of emphasizing the importance of mere density; for hot and cold platinum must be considered as of appreciably the same density for the purposes of this experiment.

The crop of assertions about the detection of X-rays from all manner of absurd sources has somewhat dwindled of late, and the loss is a bearable one. A serious attempt must be made to observe if the sun emits them by exposing suitable objects, such as bullets embedded in cork, in front of protected plates on mountain tops this Summer. The atmosphere, being equivalent to over two feet of mercury, must entirely screen these rays from lower levels; but Alpine tourists have often reported a strange fogging of plates, which they have been disposed to attribute to the warmth of a guide's back!

The production of the rays has now reached a considerable pitch of perfection; there remains much good work to be done in the direction of their better detection, especially in their more rapid photographic fixing. It is true that a few flashes will now give a radiograph of a hand, but nothing comparable to the snap-shot exposure which has been achieved in the case of light can yet be predicated of the X-rays. Their fluorescing power seems to show that they possess plenty of energy, and, of course, many attempts have been made to utilize this property directly, so as to make films more sensitive.

If the films themselves can be made to fluoresce, without otherwise being damaged, it *may* be a step in the right direction; but so far as my experience goes, which is not far, a coating of fluorescent material near the film tends rather toward a scattering and diffusion of light—a poor exchange for the straightforward penetrating property of the X-rays themselves.

Nothing better than Röntgen radiation has ever been got for throwing clear sharp shadows and giving a dense clear image. Rays which cannot be refracted, nor apparently diffracted, nor even reflected to any appreciable extent, are splendid for bringing out sharp details, and any exchange of them for the diffuse glow of any kind of phosphorescent light may be a step backward. Nevertheless, it is improbable that the present plates, put into the market for one purpose, are the best that can be devised for an altogether different, though allied, purpose, and much work of a somewhat empirical kind remains to be done by photographic manufacturers or amateurs before the most suitable kind of film is discovered.

American Institute of Electrical Engineers.

The 105th meeting of the Institute was held at 12 West Thirty-first Street, New York City, April 22. About 200 members and guests were present. A paper was read by Mr. D. McFarlan Moore, on "Recent Developments in Vacuum Tube Lighting." It was accompanied by several experiments, one of which consisted in illuminating the room by means of tubes some eight feet long, horizontally suspended from the gallery in a double row. The meeting adjourned without discussion. At the meeting of the council in the afternoon the following associate members were transferred to membership:

W. S. Andrews, Electrical Engineer, etc., General Electric Company, Schenectady, N, Y.

Henry G. Stott, Electrical Engineer, Buffalo General Electric Company, Buffalo, N. Y.

Henry S. Carhart, Professor of Physics, University of Michigan, Ann Arbor, Mich.

Russell B. Harrison, President and Electrical Engineer, Terre Haute, Ind.

It was decided to accept the invitation of the National Electrical Exposition Company, and hold the annual general meeting in the Exposition Building, beginning on May 19.

The following is an abstract of the paper presented:

In order that the spectators could more fully appreciate the advances which he had made in vacuum tube lighting, Mr. Moore first showed a small Geissler tube of the ordinary kind. He then described his vibrating contact-maker and exhibited a slide upon the screen which illustrated its construction. This vibrator is the nucleus of the invention. It is like that employed on the small sizes of induction coils with the exception that it is placed in a vacuum. Mr. Moore stated that with this vibrator currents of almost any voltage could be successfully interrupted, and in the course of the evening he used a current of 500 volts, which apparently was handled without difficulty. The vibrator is operated by a small magnet which is situated outside of the containing tube, the attraction of the armature acting through the glass. In the cuts and lantern slides no additional coils or magnets were shown, but in the experiments on larger tubes which closed the paper additional coils of considerably greater size were used placed in series with the vibrator magnets. A large variety of vacuum tubes were operated throughout the lecture, the shape of which were similar to that of incandescent lamp bulbs. These included the experimental bulbs which had been made and were shown in the order in which they had first been used, all of which, however, have been laid aside in favor of the long tubes with external electrodes. This type of tube was employed in the final experiment when the hall was illuminated. The effects produced were practically the same as those familiar to all who have seen the ordinary Geissler tube.

New York Electrical Society.

About 75 members of the New York Electrical Society visited the works of the Sprague Electric Elevator Company, at Watsessing, N. J., on the night of April 24, and were shown through the works by Mr. Frank J. Sprague. The occasion was the regular monthly meeting of the society, whose monthly gatherings partake of the nature of visits to different electric plants and works, and are therefore of the most practical kind.

President Lieb, in a few appropriate remarks, introduced Mr. Sprague, who held the attention of his visitors for several minutes in describing the works and the nature of the business carried on.

He described the development of electric elevators, and referred to the exacting requirements of modern elevator service, which he asserted were fully met in the electric elevator. The many advantages of elevators of this class over those of the earlier kinds were pointed out, and certain improvements of an electrical nature were briefly referred to. The latter relates to the operation of electric elevators from the electric lighting plant (where a building has its own plant), without causing any material variation in the light. Heretofore attempts to run elevators by the same plant that supplied the lighting current caused seriously fluctuations of light, but the improvements referred to will overcome these difficulties.

After finishing his remarks Mr. Sprague led the party through the works and explained in detail the manufacture of the various component parts of the elevator structure. As the works were running, the visitors had the benefit of seeing the actual operations of the machines, besides having their work explained. A hearty vote of thanks was given to Mr. Sprague, and after adjournment, a collation was served on the main gallery, the party returning to the city on a late train.

Where the Exposition Will Be Held.

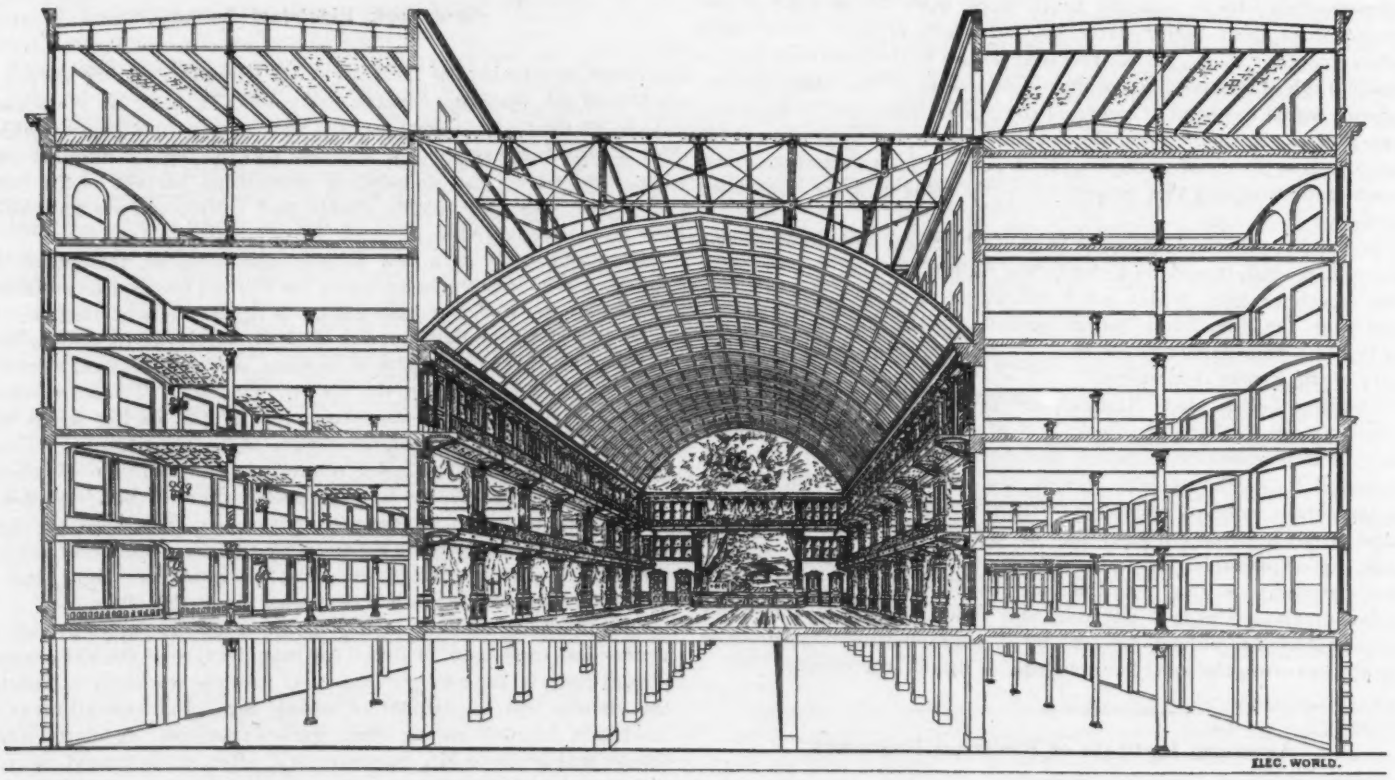
The New York Industrial Building, in which the National Electrical Exposition will be held, is situated on Lexington Avenue between Forty-third and Forty-fourth Streets. It is remarkably well adapted for exhibiting purposes and in the present instance at least is happily chosen. Our illustration will give a good idea of its size and capacity. The main exhibition floor, which will be the second from the bottom, covers an area of 55,000 square feet. The building is 200 by 275 feet in its dimensions. As indicated in the illustration the centre of the building above the second floor is in the form of an arcade. This central portion will seat over 8000 persons, and as this whole space will be occupied by the exhibitors, some idea may be gained of the spectacle the Electrical Exposition will present. Some very original designs in incandescent lighting will undoubtedly be exhibited.

Permanent expositions are usually held in the building, and the

coming exposition will necessitate the removal for the present of one or two of these. The appointments of the building are complete in every way and both visitors and exhibitors will find every possible convenience placed at their disposal. A spacious restaurant adjoins the entrance, and a roof garden adorns the top from which magnificent views of the vicinity and the East River may be seen.

The building is fireproof and well lighted, from the dome during the day, and by a splendid lighting system at night. The electrical equipment is complete, this being one of the best isolated plants in the city. A separate building is used for the power and lighting generators, boilers, engines, etc. The boiler room is below the street level, and is equipped with four return tubular boilers of 150 horse-power each. One 300-hp, one 150-hp Fishkill-Corliss, and one 100-hp Skinner engine constitute the engine equipment. Two 80-kw Fort Wayne belted generators of the Wenstrom type are driven by the 300-hp engine. The generators are belted in tandem from a countershaft. Three 45-kw Edison generators are taken care of by the 150-hp engine, while the Skinner engine is belted separately to a fourth 45-kw Edison generator. The marbleized slate switchboard is equipped with Weston and Edison-Bergman instruments. The units are so divided as to form practically two plants. The building is wired with 4000 lamps, of which 2000 are on the main exhibition floor. The capacity of the plant is 6000, therefore the disabling of one engine would make but little difference as far as the general capacity for carrying the load is concerned. Special arrangements have been made to supply current to exhibitors and mechanical power will also be obtainable. All the arrangements for the exposition will be well prepared, and every means placed at the disposal of the exhibitors to make their displays in every respect successful.

The headquarters of the convention will be in the Murray Hill Hotel, but a few blocks away, the Grand Central Depot is practically next door to the Exhibition Hall, and two lines of elevated railway are within five minutes' walk. There are numerous hotels in the neighborhood; in fact, everything needful to the comfort of non-resident members is readily available.



Sectional View of Exposition Building.

Hearing Niagara in New York.

About 40 receivers will be grouped around the little model of the Niagara power plant, on the special central platform, in the main hall of the exposition building, so that people will see Niagara run and hear it at the same time, the model itself being also driven with live or stored current from the Falls.

Programme of the National Electric Light Convention.

The following is the programme of the nineteenth annual convention of the National Electric Light Association, to be held in New York City, May 5, 6 and 7:

TUESDAY, MAY 5.

Executive Committee meeting, Murray Hill Hotel, 9 a. m.

Morning Session—Industrial Building, 10:30 a. m.

Address—President C. H. Wilmerding.

Report Committee on Rules for Safe Wiring—W. J. Hammer, chairman.

Report Committee on Relations Between Manufacturing and Central Station Companies—A. J. DeCamp, chairman.

Afternoon Session, 2 o'clock.

Paper—Acetylene Gas, L. A. Ferguson.

Paper—Single-Phase, Self-Starting, Synchronous Motors, F. H. Leonard.

Paper—Equalizer Systems of Distribution, A. Churchward.

Executive session.

Evening Session.

Lecture—The Röntgen Ray, Max Osterberg.

WEDNESDAY, MAY 6.

Morning Session, 10 o'clock.

Paper—Results Accomplished in Distribution of Light and Power by Alternating Currents, W. S. R. Emmet.

Paper—Evolution of Interior Conduits; from an Electrical Standpoint, Luther Stieringer.

Topic—The Desirability of a Standard Socket. Discussion to be opened by Alfred Swan.

Afternoon Session, 2:30 o'clock.

Paper—Evolution of the Inductor Alternator, John F. Kelly.

Paper—Steam Boilers: Their Equipment and Management, Albert A. Carey.

Report Committee on Data—H. M. Swetland, chairman.

Questions and answers.

Executive session.

Evening Session, 8 o'clock.

Lecture—The Light of the Future; illustrated with stereopticon, D. MacFarlan Moore.

THURSDAY, MAY 7.

Morning Session, 10 o'clock.

Report Committee on Finance—John A. Seely, chairman.

Paper—Evolution of the Arc Lamp, L. H. Rogers.

Paper—Electrolysis, Capt. Wm. Brophy.
Questions and answers—What is it you wish to know?

Afternoon Session, 2.30 o'clock.

Reports Secretary and Treasurer, Executive Committee. Election of officers.

This is the purely business portion of the programme, as announced by the secretary of the association. There will, however, be entertainment of a less serious kind provided for the enjoyment of members and guests, and this will be announced later.

The various passenger associations have granted the rate of a fare and a third, on the certificate plan, to delegates attending the convention. It is positively necessary that delegates when purchasing tickets should state to the agent that they are delegates to the convention of the National Electric Light Association and should obtain from him a certificate that they have paid full fare, which certificate, when properly signed in New York, will entitle them to return passage at one third the regular fare. It is absolutely necessary that this certificate be obtained when tickets are purchased; otherwise it will be impossible to take advantage of the reduced rate returning. These certificates are good going three days prior to the opening of the convention and are good to return only three days after the adjournment. The Electrical Special will leave Chicago Saturday, May 2, at 5.30 p. m., *via* Lake Shore & Michigan Southern road, arriving in New York at 6.50 p. m. on Sunday, May 3. Accommodations on this train may be secured by addressing either W. A. Kreidler, 510 Marquette Building, or C. K. Wilber, Western passenger agent Lake Shore & Michigan Southern Railroad, Chicago, Ill. The indications are that this train will be a very heavy one, and Mr. Kreidler has arranged all the details so that it will be as fine a convention train as was ever run, if not the finest.

Exhibits and Exhibitors at the Electrical Exposition.

In addition to the list of exhibits given in our last issue the following have been received:

LOAN EXHIBIT OF CORNELL UNIVERSITY.—The exhibit which comes specifically from the department of physics and electrical engineering of Cornell University, includes some valuable and important apparatus. It is such as to permit of a repetition of some of the investigations at the exposition, where they will be appreciated not only by the public but by experts.

THE WARREN ELECTRIC COMPANY, New York, will exhibit one 45-kw and one 60-kw single or two-phase multivoltage dynamos, to operate two circuits at different potentials at the same time. In connection with the exhibit the company intends to operate alternating-current arc lamps, single-phase motors, and incandescent lamps all on the same circuit. The company will be represented by C. C. Warren, president; A. M. Searles, vice-president; H. J. Medbery, treasurer; H. P. Hill, Jacob Wendell, Jr., and R. L. MacDuffie.

HENRY'S INDUCTION COIL.—Dr. R. Ogden Doremus, of the College of the City of New York will exhibit many original pieces of laboratory apparatus, including Prof. Henry's own experimental induction coil. These rare scientific curios will be supplemented by one of the cells of the historical old 500-cell battery used at the College of the City of New York; apparatus for fusing metals, apparatus for combustion of explosives in vacuo, and other rare, odd and beautiful things.

RELICS OF THE TELEGRAPH.—Mr. A. B. Chandler, president of the Postal-Telegraph Cable Company, has loaned the exposition an interesting frame of very early relics of the telegraph. It contains a piece of the wire used by Morse and Vail at the Speedwell Iron Works; a piece of the tape that was indented with the signals transmitting the news of Henry Clay's nomination; picture of the famous Speedwell shop—then and now—a portrait of Vail and some views of the early experimental apparatus.

A RÖNTGEN-RAY LECTURE FOR THE CONVENTION.—Having in mind the intense interest felt in all that pertains to Röntgen rays, the National Electric Light Association has arranged for a lecture on the subject during the convention next week, and has asked Mr. Max Osterberg to give it, with as many experiments and illustrations as possible. This will be brilliantly aided, of course, by the Edison exhibit, which it will in turn serve to explain. Mr. Osterberg has the subject thoroughly in hand, and has accumulated a great deal of unique data and material bearing upon it. The lecture is to be given on the evening of May 5.

LOAN OF HISTORICAL TELEPHONE APPARATUS.—Mr. E. J. Hall, Jr., vice-president and general manager of the American (Long Distance) Telephone & Telegraph Company, has very kindly loaned to the exposition the original long-distance telephone set, with which, some years ago, Prof. Alexander Graham Bell opened the line between New York and Chicago. It has since that time been jealously guarded, and has had a silver plate put upon it with the inscription as to date, etc. Mr. Hall accompanies this with a large picture, illustrative of the event, and with other material bearing upon the occasion. Mr. C. R. Truex has been entrusted with the care and arrangement of this interesting exhibit, which goes in the collection of the Historical and Loan Exhibit Committee.

AN EXHIBIT OF GEDNEY CHANNEL BUOYS.—One of the most picturesque features of New York harbor at night is the lane of electrically lighted buoys that marks the passage through Gedney's Channel at Sandy Hook. This is a unique installation, the current being supplied to the buoys from the shore through long runs of submarine cables. These buoys are huge spars of wood, 60 feet long, floating at a slight incline from the vertical, the lamp being carried like the head of a walking stick, and the submerged end being anchored by an iron mushroom weight. The United States Lighthouse Board has kindly placed two of these buoys, ready for lighting, one direct current and one alternating, at the disposition of the exposition management. They will be shown in a length of 12 feet, upright, and the Bishop Gutta Percha Company has been good enough to offer runs of cable to carry current to them, of the same type as that actually supplied for the real work. These buoys will be placed near the entrance to the exposition, with charts and pictures, and the visitor will thus be able to understand how it works. Such an exhibit has never before been made, and, as stated already, there is only one such installation in the world.

HISTORICAL COLLECTION OF INCANDESCENT ELECTRIC LAMPS.—Mr. W. J. Hammer's collection of incandescent lamps, to be shown at the exposition, represents, to a very considerable degree, "The History of an Art." It starts with original models exemplifying the early laboratory work of such men as Caugy, Lodyguine, Edison, Sawyer and Man, Swan, Lane-Fox, Maxim, Weston and others. In many cases these inventors and experimenters are represented by numerous forms of lamps, showing in a most interesting way the development in the art as their knowledge and experience increased. To these must be added the following, who are among the many represented in this wonderfully interesting collection, and who, by their work, have contributed to the development and practical application of the incandescent electric lamp: Muller, Diehl, Siemens & Halske, Siemens Bros., Rogers, Gatehouse, Crookes, Boehm, British Electric, Duplex, Bernstein, Pray, Van Choate, Thompson, Thomson-Houston, Shaefer, Opperman, Vitrite-Luminoid, Novac, Woodhouse & Rawson, Excelsior, Baetz, Greiner, Reinman, Richter, Green, Latimer, de Khotinsky, Goebel, Packard, Stanley, White, Westinghouse, Hammer, Jenney "D. A. C.," Perkins, Cruto, Shultzberger, Sunbeam, Fitzgerald, Franklin, Moses, Kurtzgen, Aloester, Alexander, Gerard, "A. B. C.", Sun, Seel, Remington, Neisler-Bernstein, Victoris, Mather, Swan-United, Edison-Swan, Brush-Swan, etc. This remarkable collection has been gathered from many quarters of the globe, America, England, France, Germany, Austria, Italy, Holland, Switzerland and other countries contributing. Mr. Hammer started the nucleus of it at Mr. Edison's laboratory in Menlo Park, where he was an assistant in the early days of Edison's work upon the incandescent lamp. Having charge of and assisting in many of the original experiments, tests, records, etc., he made a practice of collecting, with Mr. Edison's permission, certain lamps showing important steps in the work, believing they would some day be of great interest and value. Subsequently Mr. Edison gave him nearly all the lamps he had, which now form an excellent record of his work. To these Mr. Hammer has added from time to time during the past 17 years. As five years of this period were spent in Europe, he secured many most valuable examples of the early lamps of the foreign inventors. Mr. Hammer also exhibits the only collection in existence of the early substances Edison tried in his endeavors to secure a practical filament for the incandescent lamp.

THE WILKINSON MANUFACTURING COMPANY, Bridgeport, Montgomery County, Pa., will show two stokers of 500 horse-power, in connection with the Abendroth & Root boiler, both of which will be in operation, furnishing steam for the exposition.

THE NILES TOOL WORKS COMPANY, Hamilton, O., will have an exhibit of a five-foot radial drill that will be driven by a motor placed on the floor, a No. 1 horizontal boring and drilling machine that will be driven by a constant speed motor attached to the counter shaft,

and a 37-inch boring and turning mill that will be driven by an electric motor attached direct to the driving shaft.

The Wagner Electric Manufacturing Company, St. Louis, Mo., will display a complete line of Wagner transformers, from a switchboard transformer to a 150-kw step-up 1000 to 10,000 volt transmission converter. The company will also exhibit a selected line of high grade switches, also some fan motors. It will also illustrate the use of its ornamental economy coils, by attaching to several of these arc lamps of several manufacturers. There will be, in addition, several special devices, such as automatic fuse cut-overs, line switches and special central station main switches.

The Babcock & Wilcox Company, New York, will exhibit a steam drum composed of open hearth steel throughout with forged steel heads and crossboxes; a number of standard Babcock & Wilcox sections composed of four-inch tubes and forged steel headers, with forged handhole fittings; a forged steel header showing method of expanding tubes; a crossbox, and other examples of steel forgings made by this company. A model of the boiler as now constructed for very high pressure will be shown, as well as the original inventor's model of the Wilcox design of 1856. The company will be represented by Messrs H. F. Hewlett, W. D. Hoxie, E. H. Peabody, W. J. Reilly and E. H. Wells.

General Electric Exhibit.—The exhibit of the General Electric Company at the forthcoming Electrical Exposition will consist of a display of arc lamps for the well-known Thomson-Houston series system, alternating-current arc lamps, arc lamps for incandescent circuits and a few examples of the new long-burning arc lamp. Samples of the new Thomson inclined coil-measuring instruments, and samples of the pocket ammeters and voltmeters will occupy a place on the tables together with some of the latest productions of the recording meter department and several of the new alternating-current fan motors. A special dark room is being fitted up in which will be made a complete exhibit of all the varieties of incandescent lamps manufactured by the company, the new globular lamps, miniature and decorative lamps, lamps of a high candle-power and series-burning lamps. Types of apparatus installed by the General Electric Company will be illustrated by large bromide photographs. The space will be so arranged as to be devoted principally to the reception and entertainment of visitors. Representatives from the different sales offices and departments will be there in constant attendance to receive them, to give any information desired and to show them the representative operating plants in New York City.

The Brush Electric Company's space comprises 425 square feet, and the exhibition will be composed of an historical exhibit and a modern exhibit, the former of which is very old and the latter very new. The historical exhibit will consist of the first Brush arc dynamo, which was sold in 1877 to parties in Baltimore, who ran it for 12 years; a 16-light 2000-cp arc dynamo, which was run by the Fulton Worsted Mills, Fulton, N. Y., from Sept. 1, 1879, to April 10, 1892, when it was secured for exhibition at the Columbian Exposition; a 40-light Brush arc dynamo, which was operated by the Berkeley Company, in Providence, R. I., from Dec. 1, 1881, to May 19, 1893, when it was purchased for exhibit at the Columbian Exposition. These dynamos are exhibited just as they left the factory years ago. Not a bobbin or an armature has been re-wound, or a shaft-wire or a commutator replaced. The working exhibit will consist of a new 80-light 2000-cp Brush arc dynamo, connected direct to a 60-kw 220-volt motor. Eighty double Brush arc lamps will be hung gracefully around the exhibit and operated from the direct-connected dynamo. In connection with the direct-connected 80-light-arc dynamo will be shown in practical operation a machine running with a load of 80 lights, with a difference of potential not exceeding 1500 volts between any part of the machine or circuits and the machine still maintaining its automatic regulation. To put it more plainly, three circuits will be run direct from the terminals of the dynamo, on any one of which circuits the voltage will not exceed 1500 volts, or in other words on any one of which circuits there will not be more than 27 2000-cp arc lights. This is an entirely new method of running lamps on an arc dynamo and will be exhibited for the first time in the Brush exhibit. There will be a 100-light 2000-cp Brush arc dynamo and a 125-light 2000 cp Brush arc dynamos exhibited. These three large arc dynamos are of the very latest Brush type. They have been recently designed by the Brush Company who have already sold over 20,000 lights capacity of them. A rack of the various styles of lamps which the Brush Company manufacture will also be exhibited.

A Collection of Invaluable Morse Relics.

Mr. E. L. Morse, a member of the Historical and Loan Exhibit Committee of the Exposition, has prepared an interesting collection of early papers, models, relics, etc., relating to Morse, Vail, Henry, O'Reilly, L. D. Gale and others, and to the early days of the telegraph. As the son of Prof. S. F. B. Morse, he has, of course, facilities enjoyed by no one else for the presentation of such matter, and the result of his efforts will be of great attraction to everybody. It is hoped that this collection will be supplemented by other material from other contributors.

Among other things the exhibit will include a copy of the first wooden telegraph apparatus, letters from Peter Cooper and Cyrus W. Field, the original 1843 contract between Prof. Morse and Alfred Vail, and decorations and medals received by Prof. Morse from European governments.

A Practical Working Laboratory for the Exposition.

So many important and interesting pieces of working scientific apparatus, illustrative of some electrical principle or employed in some investigation, have been placed at the disposal of the exposition management by universities, colleges and inventors, that special provision has been made for their expert care, so that they can, wherever possible, be seen in operation by the public. With this object in view, most of this interesting apparatus has now been massed into what will be known as "A Practical Laboratory," in which will be placed all pieces with which experiments or investigations of an educational nature will be made. This will enable the public to witness some striking phenomena, many of which have rarely been demonstrated hitherto outside of the walls of a college or private laboratory.

In order to give proper supervision to this laboratory, the Exposition Company has asked Mr. Max Osterberg, of Columbia University, to act as its curator, and that gentleman has very kindly consented to serve. His familiarity with such apparatus, and his skill as an experimenter, promise a brilliant success for this novel department, which, it is said, has never been organized before at an exposition, but which realizes in a marked degree the educational purposes underlying the plans of the management. Mr. Osterberg is now laying out the plans for showing every piece of apparatus to its best advantage.

Mr. Osterberg will arrange, by permission of Prof. Crocker and Dr. Pupin of Columbia University, a set of condensers to show the speed with which a message is sent through the transatlantic cables. A great many other attractive experiments are in store for curious visitors and inquiring students.

Diffusion of Röntgen Rays.

To the Editor of The Electrical World:

Sir:—I sent you some time ago a short article on the diffusion of Röntgen rays, and at the time I was not aware that any work of a similar nature had been done, though it is true that certain suggestions had been made as to the turbidity of media, by I think, Lenard and Prof. Röntgen.

I find that Dr. M. I. Pupin has in *Science*, of the issue of April 10, given an account of his investigations on the diffusion of Röntgen rays which accords with my results in most important particulars. I was not aware that he had done the experimental work which is described in the article, and am now pleased to note that he has gone into the subject very carefully and very thoroughly—in fact, more thoroughly than my time permitted my doing.

These observations on the diffusion of Röntgen rays show that sharp, clear-cut shadows of bones or objects embedded in a considerable depth of flesh cannot be expected where the rays have to traverse a considerable depth of flesh after passing the embedded bone or object, and that blurring or diffusion which wipes out the image may be so great as to make it very indistinct if large masses of semi-transparent material are between the plate or screen and the object the image of which is to be depicted. It is easy, also, for the experimenter to be misled into thinking that the diffused rays back of the bone or object really have come through that object when in reality the presence of the Röntgen rays back of the solid object which casts a dense shadow is due to nothing more than diffusion.

I regret to hear that Dr. Pupin's valuable work in this direction has been interrupted by a serious illness.

Lynn, Mass. Elihu Thomson.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Transforming Direct Currents.—The *Digest*, April 4, contains a brief description of the Davis system; the original description was not quite clear, and it now appears that the object is to transform high-tension continuous-currents for long-distance transmission, to low-tension continuous-currents at the distant point; the latter being accomplished by the transformers described at the distant end; it seems that the high-tension direct-currents are generated directly by dynamos; a synchronous motor for driving the transformers is therefore not required.

LIGHTS AND LIGHTING.

Public Lighting by Arc Lamps. BLONDEL. Lond. *Elec.*, April 10; a continuation of his serial (see *Digest* of last week).—He discusses the quality of carbons, which has a considerable influence on the voltage, the light and the duration; according to Marks and Stine, a soft carbon gives more light than a hard one for the same amount of energy, but he claims that this is true only for short arcs, the contrary being the case for long ones; a high temperature while baking, seems to have a good effect in expelling the hydro-carbons which cause flaming, and it also increases the conductivity; carbons converted into graphite in an electric furnace have special properties making them useful as negatives, the electrical and calorific conductivity being too great for positives, and the arc being too unstable; they may be considerably reduced in diameter without increasing the consumption; cored carbons enable the voltage to be lowered, but at the expense of the efficiency, as the intrinsic brilliancy is perceptibly lowered, in one case from 160 to 120 candles per square mm; chemical analysis is almost useless in determining the quality of the carbons, a much better method being to denote their behavior, including also the variation of the voltage which is possible without causing hissing or flaring; a photometric measure should also be taken of the total luminous flux, by means of his lumen-meter; the method of defining arcs by the energy which they absorb, he states, is absolutely irrational, and is calculated to hinder all progress; he shows the absurdity of quarreling about 2 per cent. in the dynamo efficiency while variations of 100 to 200 per cent. are allowed in the lamp. He discusses the fittings for public arc lamps, giving a large number of illustrations of those used in Europe. Regarding the utilization of the light, he states that the problem is to diffuse the light in the best possible manner, that is, to soften the brilliancy and distribute it in the most advantageous manner; the comparative value of different fittings may be determined by the luminous efficiency, which is the ratio of the useful flux of light of the lamp with its fitting below the horizontal to the total flux produced by that arc.

Life of Incandescent Lamps. SMITH. Lond. *Elec. Rev.*, April 10.—A brief note giving the lives of some very long-lived lamps which have been used on an alternating-current plant; the average lives of quite a number range up to 5000 and nearly 7000 hours, while the maximum reached 23,000; there are four lamps still in use which have run over 30,000 hours; nothing is said about the fall of the candle-power.

POWER AND HEAT.

Electric Turrets. West. Elec., April 25.—A translation in abstract, with the illustrations of the article noticed in the *Digest*, April 11.

TRACTION.

Accumulator Traction at Birmingham. Lond. *Elec. Eng.*, April 10.—A short article on the Birmingham lines, with special reference to the accumulator system; the trolley system it is thought will soon be introduced. The accumulators now in use are the chloride, which were installed about 18 months ago; there are 17 batteries; the length of the line is a little over three miles of double track, and the number of cars varies from five to nine; batteries weighing from 1.75 to 2.75 tons on cars weighing, without the batteries, but with passengers, about 10 tons, have been tried; a battery consists of 72 cells of the type which will run about six hours when new; it is considered inefficient when it refuses to do less than a two hours' run; there is not sufficient data to justify any definite statement about the life. The Epstein cells were introduced in 1892; 12 sets of 92 cells made an average car mileage of considerably over 15,000 miles without renewal; they were run under a maintenance contract of 3 cents per car mile, an arrangement which it is thought should have proved profitable to the contractor and might have been reduced; with these cells cars ran very regularly under the trying conditions of a severe winter; the cars ran better than those on the other systems in Birmingham (horse, cable and steam). At present the accumulators are not bought outright, but are rented on the basis of car mileage; the Epstein cells ran a total of 188,000 car miles at a cost of about 28 cents per car mile, a rate which it is thought might be reduced; there is no information available regarding the E. P. S. cell; the present contractors consider the conditions of running on this line are very much against the financial success of the accumulators; the actual cost for batteries is less than 10 per cent. "of the total cost per mile run."

Secondary Batteries for Locomotion. FITZGERALD. Lond. *Elec. Rev.*, April 10; a continuation of his article (see *Digest* last week).—It is devoted entirely to a discussion of the proper density of the acid, pointing out the advantages of his "afluidic" system, in which there is "a suitable absorbent to prevent the free movement of the electrolyte." He gives formulas for calculating the weights and volumes of the acid after having decided what should be the initial or the final percentage of the acid in the electrolyte; if this difference is small the weight of the liquid will be excessive; if it be too large then either the initial strength may be detrimental or the final conductivity too low. On the one hand it is desirable to work only a little above and below the percentage (29.6) of real sulphuric acid, which gives the maximum conductivity, the specific gravity being 1.215; on the other hand it is desirable generally to avoid a specific gravity as high as 1.200 on an excessive bulk of electrolyte; at 1.300, corresponding to 40 per cent., persulphuric acid is freely generated in charging and the hydric peroxide generated by its decomposition may be more detrimental to the plates than strong acid; with his afluidic system it may be not only safe but advantageous to use acid of such strength "as to be dangerously inductive of local action under ordinary conditions." He calculates the weights and volumes of the acid for several cases, showing the advantages of his afluidic system by means of which the acid may be used at a specific gravity as high as 1.300, thus working down to the density of maximum conductivity, 1.215, thereby realizing the conditions for a constant current with a sudden fall. He showed by calculation that the total weight, including that of the "absorbent," is less than that of the dilute acid in the ordinary system. A similar calculation is made for the chloride T. B., 5, cell, which weighs complete 38 pounds, of which about 13 is electrolyte; he shows by calculation that the excess of acid is 69 per cent., and the battery itself is therefore 16 per cent. heavier than it need be; in the afluidic system the weight of the acid, together with the absorbent, would only be about half as great, reducing the weight 16.5 per cent. Whether it is practicable to construct cells in which so large an amount of space is taken up by the plates "must for the present be an open question."

Electric Traction in Europe. Lond. *Elec. Eng.*, April 10.—A copy of a report of the deputation appointed by Belfast to visit various towns in Europe where electric traction is used.

Electric Conductivity of Cement and Concrete. Lindeck. Lond. *Elec.*, April 10.—A transiation in abstract, with the illustrations and tables of results, of the article abstracted in the *Digest*, April 11; see also April 25, under Insulated Rails.

Electricity on Steam Railways. BAXTER. *Elec. Eng.*, April 22; (see *Digest* last week).—He calculates the capacity of steam locomotives and electric motors at different speeds, on the basis of Crosby's result that the atmospheric resistance varied as the velocity and not as its square; the results are based on continuous running as distinguished from spurts. His figures show that motors giving a horizontal effect of 6,220 pounds could draw cars weighing 140 tons at a speed of 100 miles per hour, or with 10,000 pounds, a train weighing 358 tons at a speed of 150 miles per hour, which equals 4,000 horse-power. He endeavors to calculate to what extent the speed could be increased by electric means without increasing the cost of coal per hour, and finds that for the same coal for a speed of 70 miles per hour with a train of the weight of the Empire State Express using a steam locomotive, the electric motors could make a speed of 108 miles per hour, showing that much higher speeds are possible with electric motors.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Regulation of Pressure. Lond. *Elec.* and *Elec. Eng.*, April 10.—A long abstract of the discussion of the paper of Messrs. Cowan and Still (see *Digest*, last week). Mr. Rider agreed that 750 amperes per square inch was a very safe working current for a feeder; also that the feeder should be determined by the current without considering the drop; the method of regulation described was one which he was using and could recommend highly, but it can be used only when the different feeders, with their net-works of mains, were distinct from each other and not united. He did not favor the proposed method of reducing the light load losses;

he suggested using an open coil alternator without iron in the armature, in order to reduce these losses; he thinks the governor would not regulate well for such a reduction in speed; their method would reduce only the station losses and would increase the outside losses. Mr. Mordey praised the paper very highly; there was little advantage in using transformers above 12 or 15 kilowatts, on which the no-load losses were only about 1 per cent., as this would not be lowered much by using larger ones; the lower cost per kilowatt of larger ones had to be compared with the extra cost in mains and the greater inconvenience in handling. He objected to the usual way of considering that the capacity current was in advance of the E. M. F., as this was wrong; to say that a capacity sucked the current out before the applied E. M. F. was to say that the effect preceded the cause; what really happens is that the current is made to lag still more by capacity than by self-induction, it being just in front of the succeeding wave; for mathematical purposes the usual method is more convenient. He praised the method of regulation; he found that by raising the voltage by an augmentator the actual power absorbed was less than by the alternator alone if worked to the full voltage. A large self-induction in an alternator lessens the shock on short circuit, but the machines regulate badly and there is a large drop; with an augmentator, however, there was self-induction, but only when the machines were out of step, it having no effect on the regulation at other times, which is a valuable feature in this system. He did not favor the methods proposed for reducing the alternator losses at light load, and thought the machine experimented with was an unfortunate one for that purpose; it was the engine losses rather than the alternator losses that ought to be reduced for light loads; losses in even a large alternator are so small that he suggested using a small engine in connection with some clutching device, by means of which the alternator could be driven by this small engine in the daytime. The short-circuit current of an armature without iron need be no more than in those with iron cores; his machines when short-circuited, with full steam on, generally did not give more than three times the normal current; this can be accomplished without sacrificing the good regulation quality, which he considered very important. Mr. Statter thought the cost of laying should be added to the cost of the feeder in determining the 10 per cent. interest and depreciation, instead of using the cost of copper and insulation only. Mr. Wordingham thought their calculations concerning the most economical size of feeders were unassailable, and that the figure 750 amperes per square inch agreed fairly well with his own practice. Mr. Nisbett thought that the cost of the mains, armoring, repairing the pavement, etc., ought to be included, as also the depreciation of the trench, which practically wears out, and this would make the economical current density very much higher. Thomson's law, if these factors be considered, would show that the economical section would be such as to make the mains red hot every evening. He favored sub-stations; the cost of pressure wires was not a serious item; he favored the use of a boiler pump driven by an electric motor, which he thinks is very much better than an injector. Mr. Hesketh did not favor reducing the speed of the engine. Mr. Lindley did not approve of it either, as the engine would have to be stopped for both the changes; the power of a good compound engine could be reduced to one fifth of the full load without serious falling off of economy. Mr. Still in reply maintained that in applying Thomson's law the capital cost is only that portion of the total capital outlay which depends on the amount of copper in the feeder; the laying of the mains, the trenching, etc., do not depend on the size of the cable and are standing costs, which should not be considered any more than the transformers and even the generating plant; the wearing out of the trenches was a question of the choice of the system and not of the cross-section of the cable; the extra cost of drawing in a heavy cable and the increased cost due to a larger size of conduit, should be taken account of, if appreciable; the proof that costs which are constant cannot affect the economical size is shown mathematically, as the constant does not appear in the differential equation for determining the minimum; in practice there is no excessive rise in temperature in the cables determined in this way. He did not agree with Mordey regarding the phase shifting of the capacity current; in such wave motions no beginning or end is to be considered. Mr. Cowen in reply stated that it was not the saving in the alternator but that in the engine which was to be considered for light loads; governors would work if the leverage and not the tension of the springs be altered, and this could be done without stopping the engine; he believes that motors are unfit for lighting circuits, especially when they are alternating-current motors; if motors became popular the electric light would become unpopular; it is impossible to regulate properly with alternating-current motors on the circuits.

Editorially the Lond. *Elec.* states there are two ways in which the engine speeds may be reduced without reducing the frequency, one is by using a variable speed gear, which, however, does not exist; another is to keep the relative speed of the armature and feed coils constant by reducing the absolute speed of the armature to one half at low load by rotating the fields in the opposite direction; the frequency in that case would remain constant. The editorial also comments on Mordey's suggestions; it would follow that to produce a genuine lag there must be an opposing E. M. F., whereas the E. M. F. introduced by capacity is essentially assisting the impressed E. M. F.; the slightest trace of a capacity would then produce a lag of a whole period and the slightest increment of that trace would cause only a small diminution in that enormous lag, while the greatest possible capacity would only reduce the lag to three quarters of a period.

Dusseldorf. Elek. Zeit., April 2.—Tabulated data showing the operation of this station for the year ending March, 1895; accumulators are used for over half the energy supplied by the station.

Three-Phase Lighting Plant at Salt Lake City. Elec. Eng., April 22.—A brief description accompanied by a few diagrammatic illustrations.

WIRES, WIRING AND CONDUITS.

Wiring Rules. Lond. *Elec. Rev.*, April 10.—A discussion of two new sets of rules, one of an insurance company and the other of the St. Pancras vestry, for 220-volt wiring.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen Rays. Lond. *Elec. Rev.*, April 10; a report of an interview with Mr. Jackson.—It appears that he discovered, like Lenard, some years ago, that the radiation from Crookes tubes produced phosphorescence outside of the tube, and that pictures might be shown on phosphorescent screens of metallic objects enclosed in opaque boxes; it is thought that he has done more perhaps than any one else to make X-ray photography a practical success; he is the inventor of the now well-known focus tube (see *Digest*, April 4) and it is thought that he brought the phosphorescing screen to its present state of perfection; the focus tube was invented by him about two years ago. He does not use the Sprengez pump in the manufacture of his tubes, but uses instead a double Fleuss pump improved by him, the two cylinders being in series; it is essentially a mechanical wash-out pump and will produce a vacuum "sufficient to resist an 8-inch spark." If the fluorescing screen is placed anywhere "at right angles to the plane of the platinum reflector and intersecting it, the screen is dark on one side of the line of intersection, while on the other side of this line it phosphoresces with its full brilliancy. This shows that the X-rays are reflected from the platinum plate with equal intensity in all directions, even in the plane of the plate itself, and that a very small percentage of the radiation passes through the plate"; the green phosphorescence from the tube he thinks is due to the air condensed on the surface of the glass and the flickering he attributes to a movement of this layer of air. It is said that his focus tubes are equal if not superior in intensity and penetrating power even to the Tesla apparatus, in which a far more powerful source of energy is used; he has taken photographs of the hand in a fraction of a second by placing the phosphorescing screen in contact with the sensitive plate; without the use of the screen, sharply defined "esographs" of the hand can be taken in 1.2 minutes. He has found that the best phosphorescing substance is potassium-platino-cyanide, which gives about twice as great an intensity of light as tungstate of calcium; he thinks Edison's mistake was due to his using an insufficient quantity of the potassium salt; Jackson uses two thirds of an ounce to cover a screen six inches in diameter; the finely powdered crystals are supported in mucilaginous vehicles on a disc of black cardboard; with this disc it was possible to distinctly see bones in the thickest part of the body; the jaw bones could be seen while working, as also the outline of the skull, but there was nothing to indicate the presence of the brains inside." Regarding theories, he favors the ultra-ultra-violet light view, the wave lengths being so extremely small that they are not refracted, polarized, etc.; he thinks cathode rays consist of very varied amplitudes and periodicity, like a noise in the theory of sound; when these strike a solid body they are transformed into waves of a few definite periodicity; the X-rays are the notes of the highest periodicity and shortest amplitude.

Klingenberg. *Elek. Zeit.*, April 2.—A reprint, with a number of illustrations, of a recent paper read before the Electro-Technical Society; the greater part of the paper is introductory to the subject of Röntgen rays and gives a description of the action of Geissler and Crookes tubes and phenomena connected with them. Among other things he shows why a good induction coil gives a current in only one direction; during the increase of the current in the primary a low voltage is produced in the secondary in one direction, and by the sudden fall when the circuit is opened a very high voltage is produced in the secondary in the other direction; to obtain sparks for both currents the terminals of the secondary must be brought very close together. He describes in detail the behavior of tubes at successive degrees of exhaustion, dwelling on that of Geissler tubes in particular, in which the vacuum corresponds to about 1 mm of mercury; in these about 90 per cent. of the energy is transformed into light; the sparking distance in a spark gap connected parallel to the tube is a very convenient method of measuring the degree of the vacuum. He explains the three characteristic properties of cathode rays which distinguish them from the action in Geissler tubes, the first being that the rays are perpendicular to the cathode and independent of the position of the anode, while in Geissler tubes they follow the curvature of the tube; the second is that they produce fluorescence on the glass and the third, that they are propagated in straight lines; solid bodies transmit cathode rays only slightly, if at all; other well-known Crookes experiments are described; Goldstein found that rock salt is colored yellow by these rays; he also placed photographic plates inside of the tube and found that they blackened. The experiments of Lenard and Hertz are described. The final portion, which refers to Röntgen rays, gives little that is new; Röntgen showed that there was no appreciable refraction by passing the rays through pulverized glass, which he found was as trans-

parent as solid glass; this proof was considered conclusive; he also proved that reflection took place from the surface of metals. He describes some experiments made by him; among other things he found that the effect was increased by increasing the number of breakages of the current, and he therefore used a rotating breaker, made of a toothed wheel, the break occurring under running water; the action is made still greater by using alternating currents, but these are apt to destroy the tube, owing to the heat, notwithstanding the methods of cooling with oil of petroleum; good results were obtained with "Tesla currents," with which the heating was much less; he placed a condenser in the secondary circuit also; that is, in parallel with the tubes; the electrodes in the tube are consumed.

Röntgen Rays. Lond *Elec.*, April 10.—Brief abstracts of a number of papers from the *Comptes Rendus*, March 30, many of which are said to be of unusual interest. BENOIST and HURMUZESCU can find no trace of electrification by X-rays; they find that the time taken for a given fall of potential to occur, is different for different bodies; they conclude that the "aptitude with which the different metals utilize the energy of the X-rays to dissipate electricity, clearly varies inversely as their transparency for these rays;" the conducting dielectric theory of Thomson does not explain the phenomenon.—SAGNAC, in a long paper on diffraction and polarization, finds that the rays with which he experimented do not possess wave lengths greater than four hundredths of a "micron" and he can discover no signs of diffraction or polarization.—HENRY endeavors to co-ordinate the results up to date; he thinks it almost certain that they are transversely vibrating ultra-violet waves; that they do not show interference phenomena, is correct according to theory; they are not refracted; according to Stokes' law, phosphorescence is due to the absorption of short waves in their transformation into longer ones, "hence X-rays are ultra-violet waves"; he believes cathode rays are merely X-rays "complicated by material convection, and that they become converted into X-rays on entering dense media, and that all sources of light emit X rays; phosphorescent bodies exposed to electrical radiation emit Röntgen rays.

The Lond. *Elec. Eng.*, April 10, states that according to *L'Elettricita* it has been discovered that ordinary sunlight, which has been abnormally refracted by fuchsin, contains components which appear to have the power of passing through cardboard, leather, wood and black cloth.

Chemical Action of Röntgen Rays. ZICKLER. *Elek. Zeit.*, April 9.—He endeavored to find whether the action of the sensitive film was direct, or whether it was due to the fluorescence. Two similar plates were exposed to a tube which was completely covered with black material; suitable objects were then photographed, first by placing a fluorescent screen next to the plate, and then by using a plain screen without fluorescent material next to the plate; the exposure was in each case five minutes; in the first experiment the fluorescence was distinctly visible to the eye, while in the second case there appeared to be none; on developing the plates both were found to be equally intense, while in the second case the image was sharper. This shows that the action is direct, or at least that the direct action predominates.

Fluorescent Screen for Röntgen Rays. LEICK. *Elek. Zeit.*, April 2.—He states that Prof. Richarz used a fluorescent screen as early as Feb. 5, for demonstration purposes, thereby anticipating the cryptoscope of Salvioni and the similar apparatus of Spies; he increased the intensity of the light by increasing the amount of fluorescing substance; the latter was placed between two glass plates about 8 x 4 inches, and the amount of material used was 20 grams of barium-platino-cyanide; the intensity was sufficient to see all the bones of the hand, and also all in the lower part of the arm; it was possible with this apparatus to show the results simultaneously to a large audience.

Seeing by Electricity. PROBERT. Lond. *Elec. Rev.*, April 10.—A brief, illustrated communication under this heading, describing some experiments in which a photograph dry plate was dampened with distilled water and had fork-shaped pieces of tinfoil pasted on it, which were connected to a series of three accumulators for one minute; both the electrodes became visible on developing the plates, as also a faint line starting out from one of them; he states that the current must have been extremely small, and that this experiment shows how extremely sensitive photographic plates are toward electric currents.

Experiments on the Hall Phenomenon in Bismuth. LEBRET. Lond. *Elec.*, April 10.—An article showing dissymmetric results which increase greatly with the magnetic field, and he thinks there is a chance that the strength of alternating magnetic fields might be measured by the amount of this dissymmetry.

Röntgen Ray Investigations. TESLA. *Elec. Rev.*, April 22.—His investigations with reflection have confirmed his opinion that Volta's electric contact series in air are identical with the order of the metals arranged according to their power of reflection, the most electro-positive metal being the best reflector; platinum is the poorest and sodium one of the best; this order is approximately the same as that with reference to their energies of combination with oxygen; should this be confirmed by other physicists, the following conclusions would be justified; first, that highly exhausted bulbs emit material streams which are reflected from metallic surfaces; second, these streams are formed of matter in some primary or elementary condition; third, the streams are probably the same agent which is the cause of the electromotive tension between metals in close proximity; fourth, every metal or conductor is more or less a source of such streams; fifth, these streams must be produced by some radiations which exist in the medium; sixth, streams resembling the cathodic must be emitted by the sun, and probably also by other sources of radiant energy; these conclusions are discussed in detail. He predicts that if a sensitive film is placed between a magnesium and a copper plate, a true Röntgen shadow picture would be obtained after a long exposure in the dark; he thinks it probable that there is a continuous supply of such radiations from the medium in some form, and that they come from the sun, from which he concludes that with very long exposures Röntgen shadow pictures could be obtained from all sources of radiant energy, provided the radiations are permitted first to impinge upon a metal or other body; he suggests that the lumps of matter composing a cathodic stream in the bulb are broken up into small particles by impact against the walls of the tube and are thereby enabled to pass into the air; the difference between Röntgen and Lenard rays is that the particles composing the former are incomparably smaller and have a higher velocity, which he believes is the reason why they are not deflected by a magnet; he tried to find whether the deflected rays possessed distinctive features but could notice no difference; it is important to find out what becomes of the energy of these rays; his tests have confirmed Röntgen's statement that the rays are incapable of raising the temperature of a body. He has increased the efficiency of the reflectors by providing separate successive layers for reflection, by making the reflector of thin sheets of metal or mica. He recalls a former experiment in which a brush or stream issuing from a single electrode rotated very rapidly due to the earth's magnetism, and he thinks that perhaps the Lenard and Röntgen streams also rotate under the action of the earth's magnetism. He does not favor the idea of vibrations approximating those of light and thinks that all these effects could be produced with steady electrical pressure like that from a battery, with the exclusion of all vibrations; he found no effect due to changes of the frequency although it was varied between wide limits; to obtain clear shadows it is very important to pass the rays through some tubular reflector which makes them approximately parallel; clearer pictures were obtained by using very thick films developed very slowly. He has succeeded in making the radiation more powerful and describes and illustrates his new form of apparatus in which the rays were made to pass through various thicknesses of circulating oil; with this apparatus he claims to have obtained better results. By mixing a non-fluorescent powder with the fluorescent material for a screen he found that the general brightness was diminished, but that the shadows were sharper; the vertebral column could be seen quite clearly even in the lower part of the body, as also the outlines of the hip bones; he located the heart unmistakably, the background for which appeared to be brighter; the bones of the hand could be seen very clearly through sheets of copper, iron and brass nearly one fourth of an inch thick, and through glass the rays seemed to pass with great freedom, one half an inch of glass hardly dimming the fluorescence; it appeared sometimes as if the bones and flesh were equally transparent to radiations passing through the oil; the motion of a hand could be clearly seen through the body; it is of advantage to determine by means of the screen the proper distance at which an object should be placed before taking the photographic impression. The effect noticed by Prof. J. J. Thomson, that bodies traversed by these rays became conductors, was further investigated, but the conclusion could not be confirmed, and he (TESLA) claims that it is a further evidence of the existence of streams of matter, but not that the bodies become conductors in the common acceptation of the term.

Kinematics of the Röntgen Rays. STINE. *Elec. Eng.*, April 22.—He found that a limited circular area of the bulb opposite the cathode was the prime source of the ray, but the entire inner surface of the tube is a more or less weak secondary source; he showed that there appeared to be no refraction; also that there was no reflection; experimenters who have claimed to have found reflection seem to have ignored some of the most elementary principles of physics; the reflection of a wave is molar and for 45 degrees should have been in excess of 50 per cent.; a slight reflection would indicate molecular and not molar origin; he thinks the slight reflection noted was due to the surface acting as a secondary source of the ray; regarding diffraction he states that the apparent results obtained were purely penumbral and describes an experiment to illustrate this; he discusses the subject of interference and shows how the apparent results may be explained; if the lines noticed had been due to interference they would have been hyperbolic. He does not favor the sound-wave theory; he thinks the evidence in favor of the longitudinal nature of the rays is so increasingly strong that it seems well-nigh impossible to explain it away.

Is the Röntgen Radiance Germicidal? El'ty, April 22.—Profs. Pratt and Wightman, of Chicago, claim to have definitely proved by experiments on cultures that the Röntgen ray was fatal to the bacilli of cholera, diphtheria, influenza, glanders, pneumonia, typhoid, tuberculosis and anthrax; experiments here and abroad by others gave negative results; the present article gives the opinions of a few authorities on this question. Dr. Morton was very skeptical about the efficacy of any such treatment; both the bacilli and the healthy tissues of the body are cells of practically

the same kind, so that any agent which affected one was likely to affect the other in exactly the same way ; a destructive agent would therefore have to have a selective power to discriminate. Dr. Pitzer stated that while the ray may destroy the bacilli when acting directly on test cases he does not think it can ever be of any great value in the treatment of the diseases depending on these bacilli. Dr. Bleyer believes that at present he does not think the rays will accomplish this object, but that if sufficiently high vacua and potentials could be brought to bear on the bacilli, it is not possible to say what the rays will do ; it is not well to venture a certain opinion without experiment ; he shows that light rays have a decided specific action on bacilli, but whether it is the action of the whole spectrum or of certain parts of it is still a question ; he thinks there is no doubt that a sterilizing effect will be produced on bacilli "when we can give them the potential" ; he thinks ozone would be generated in the blood if the radiation be made sufficiently powerful, and ozone "is the only powerful germinicide and bactericide in existence." Mr. Edison stated it is not a matter of opinion but of experiment. Dr. Gibier said, Why should it not be so ?

Influence of Temperature on X-Ray Effects. Edison. *Elec. Eng.*, April 22.—The relative permeability of different materials is not constant; he placed a tube in a jar of paraffine oil which was contained in another jar of ice, and found that the rays coming through the oil had a different character; the hand showed scarcely any differentiation between the flesh and bone, both being almost equally transparent; a sheet of steel one sixteenth of an inch thick usually cuts off all the rays in air, but in the present case the steel was quite permeable. He believes that it was either the low temperature increasing the wave length or that the oil had absorbed the short waves; if the latter is correct, materials may be found to permit only short waves to pass, thus giving sharper shadows. Bulbs which are spherical are liable to be burst, due to the heat of the glass; the best remedy is to make the ray strike the glass at a low angle.

Lightning Shadowgraphs. Knudson. *El'ty*, April 22.—He described an incident which occurred seven years ago, in which an alleged photograph or shadowgraph of a young lady's face was produced on a brass placque by lightning; after a lightning flash near a dwelling it was discovered that "as an undoubted result of this flash" the profile of the face "was quite clearly placed" on the placque in the same room, near where she stood at the time. Experiments which he made with the discharge from Leyden jars resulted in producing outlines of an object on a frosted aluminum plate, although they were not very distinct.

X-Ray Photographs With a Wimshurst Machine. Rice. *Elec. Eng.*, April 22.—He endeavored to produce a continuous glow by connecting the tube directly with the knobs of the machine without the use of Leyden jars or succession of sparks, and was successful ; only the bright spot opposite the cathode gave off any rays ; he obtained good pictures with a 20 to 30 minutes' exposure, the two knobs being about one quarter of an inch apart; he found that the rays emanated from the glass and not from the cathode.

Röntgen Ray Air-Wave Theory. E. P. Thompson. *Elec. Eng.*, April 22.—He presents an argument against the theory of material particles ; a shadow of an uncharged tube was outlined on a fluorescent screen, from a charged one, and he considers this as evidence that the rays passed through the vacuous space ; he suggests making an experiment with a fluorescent plate suspended by threads in a vacuum tube.

ELECTRO-CHEMISTRY AND BATTERIES.

Commercial Electric Antimony. Lond. *Elec.*, April 10.—A note from the *Zeit. fuer Elektrochemie*, stating that Siemens & Halske are now preparing antimony by electrolysis, of considerable purity and in a convenient form; it consists of dense gray plates about two mm thick, having the warty surface characteristic of antimony; a solution of antimony trisulphide in an alkaline sulphide is used; an analysis is given, showing that it is almost pure and may be used without further refining.

Accumulator. Lond. *Elec.*, April 10.—A note stating that a gold medal is being offered by the Société Industrielle de Rouen for an improved accumulator "having advantages in respect to efficiency, etc., over existing types"; the competition closes Sept. 30; full particulars may be had from that society, 2 Rue Ampere, Rouen, France.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Loss of Energy in Hysteresis. Searle. Lond. *Elec.*, April 10.—A reprint of a short Cambridge Philosophical Society paper, in which he suggests a simple and rapid method by which the loss is determined by a single observation of the throw of a spot of light on a scale; he admits that it is still imperfect but considers it of sufficient interest to justify being noticed. The iron bar is placed in a solenoid through which a current passes in series with a sensitive electrodynamometer; a secondary coil is wound over the iron and is connected with the movable coil of the instrument; when the current is changed, the throw of the coil is proportional to the energy lost in hysteresis; the conditions and the theory are given, as also the method of calibrating the apparatus. The method applies to a maximum value of the magnetizing force; after having determined the constant, all that is necessary is to find the throw produced by one double reversal of the magnetizing current; (it appears that a steady current is passed through the coil and then reversed by means of a commutator, the throw being noted). If the loss is to be determined for a maximum magnetic induction, it is a little more complicated as the value of this induction must be found by the ballistic method; the method can be used for very small samples of iron. At first he obtained only very crude results but afterward reduced the error to about 5 per cent.; with a proper reversing key the results agreed, within the limits of accuracy of the observations, with those obtained by the usual method.

Measuring Three-phase Currents. Dobrowolsky and Bauch. *Elek. Zeit.*, April 2.—Both refer to the method proposed by Behn-Eschenburg (see *Digest*, April 11); the former states that it is not correct to claim that the apparatus will measure the watts of three-phase currents with unequal loading of the branches; if for instance one of the circuits was without current there would be no deflection in the wattmeter; the method however can be of value for motor work if the load is equal on all three branches, as the neutral point need not be used as ordinary wattmeters can be employed. Bauch shows analytically that when the branches are unequally loaded, the readings will be incorrect.

Universal Shunt. Lond. *Elec. Rev.*, April 10.—An illustrated description of a system of adjustable resistances, apparently devised by Rymer-Jones, giving a multiplying power from one to ten thousand.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Exchanges and their Working. Sinclair. Lond. *Elec. Rev.*, April 10; a reprint of the complete Institution paper with the illustrations.—There appear to be no new suggestions for better working, it being devoted chiefly to switchboards, favoring the flat-board type; the paper is editorially discussed and it is there stated that "there is but little bottom in his arguments on behalf of the flat board."

Protection of Telephone Lines Against Railway Circuits. Pierard. *Elek. Zeit.*, April 9.—A German translation in abstract of the article noticed in the *Digest*, Nov. 30, 1895.

French Transatlantic Cable. Lond. *Elec. Rev.*, April 10.—The beginning of a translation of the article from *L'Elec.*, noticed in the *Digest*, Feb. 15.

Telegraphic Typewriter. Lond *Elec. Rev.*, April 10.—The Kamm system is briefly described; two similar instruments at distant ends of the line produce the same signs when one of them is operated.

International Telegraph Conference of 1896. Lond. *Elec. Rev.*, April 10.—A brief notice.

MISCELLANEOUS.

Electricity in Horticulture. West. Elec., April 25.—An extract accompanied by some illustrations from a recent report of Prof. Bailey on six years' experiments at Cornell University and referring specially to those in which the arc light was screened by the glass, the light being placed outside of the glass hothouse. There were two houses, both of which were exposed to sunlight during the day, and one of which received in addition the light from an arc light for a part of the night; the lamp was surrounded by a clear glass globe. It was found that there was a decided beneficial influence on lettuce and there can be no longer any doubt as to the advantage in forcing this plant; the seed should be sown under ordinary conditions, and when the plants are well established they may be placed under the light; at distances up to 40 feet where there was only diffused light, improvement was also noticed; the effect of a shadow of a rafter on the leaves, could be noticed. Mr. Rawson, near Boston, now uses the electric light in the commercial forcing of lettuce; there are three lamps of 2000 cp each which are run all night, and the house covers nearly one third of an acre; he finds that he receives a gain of five days per crop, which for three crops during the winter makes a gain of two weeks; the gain from one crop is estimated to pay the cost for running the lights all winter; the effect is marked at a distance of 100 feet. Bailey, from a number of instances, draws the conclusion that the electric light does not determine the periodicity of growth, that increase occurred only during the first days, and that growth took place in both houses in daylight as well as in darkness; the influence of the arc light is greatly modified by the use of clear glass, and plants which are injured by the naked light may be benefited by the other; as a rule the plants are earlier; an average of five hours of light per night hastens the maturity of lettuce from a week to 10 days, at a distance of 10 to 12 feet; the light appeared to injure young newly transplanted plants; radishes are not benefited to a great extent, and were injured by the naked light; beets, spinach, are slightly benefited, cauliflowers grow taller and have fewer and smaller heads; violets and daisies bloom earlier; plants which are benefited simply grow more rapidly during the customary periods; he is convinced that the light can be used to advantage in forcing some plants.

Carbide of Calcium and Acetylene. Prog. Age, April 15.—A large portion of this issue is devoted to this subject and includes a report by Profs. Houston, Kennelly and Kinnicutt, which was made for that journal; besides this report, which forms the greater part of the article, there is also an introduction to the subjects of carbide of calcium and acetylene, with a history and a list of the properties; also a list of the patents and a bibliography of the subject. The report of Houston, Kennelly and Kin-

nicutt was made to settle the question of cost of the material; they visited the works of the Wilson Aluminum Company, at Spray, N. C., and made an examination and test of the process of manufacture of calcium carbide, as it is carried on there. The report is given in all its details, only a few of which can be given here. A description of the plant is given; it includes two alternators of 120 kilowatts, operating at a voltage of 1155, the currents being transformed down to about 100 volts for furnaces. In the very carefully made tests two complete runs were made in the same furnace on two different days; in the first one 1200 pounds of lime and 800 pounds of coke were placed in the mixer, and thence in the furnace for three hours; the mean primary current was 156 amperes at 1000 volts; the charge which was taken out consisted of 226.5 pounds of gross calcium carbide and 1332 pounds of mixture unacted upon; the second run was somewhat shorter, namely two hours and 40 minutes and contained about the same charge, the resulting material being 203 pounds gross calcium carbide; the mean power was 205.6 horse-power at the transformers, and 195.3 at the furnace; the average yield of the net calcium carbide was 5.09 cubic feet of acetylene per pound. A detailed table of the yield of calcium carbide in these test runs is given; in this it is stated that the pounds of gross carbide per furnace hp-hour averaged 0.3905, and the net carbide 0.3723. The methods and results of the chemical analysis are given. This is followed by a detailed estimate of the cost, the concluding figures of which are as follows: Cost of plant, $11,955; labor, $11; materials, $14.39; these together with power, ($3.37), interest, depreciation, etc., amounted to $32.767; this is based on an output of gross carbide of 2,000 pounds per 24 hours; the freight charges on lime and coke are very heavy at Spray and add materially to the cost. The net carbide gave an average yield of 4.926 cb. ft. of acetylene gas per pound; pure calcium carbide should yield theoretically about 6, so that the net carbide averaged 82.1 per cent. of the theoretical yield. This report is followed by a supplementary one by Messrs. Houston and Kennelly, in which they give an estimate of the cost of manufacture on a more extended scale and at a locality where the materials would be less expensive; they assume a plant having an output of five short tons of the gross material per day and operating 300 days a year, by water power, which latter costs $5 per horse-power per year; the investment will be $44,700, the labor $7,550, insurance, taxes, interest, depreciation, oil, etc., $5575, water power and rent at the rate of 1200 horse-power $6000, materials $10,937, making a total of $30,062 per year for 1500 short tons of gross carbide, which amounts to $20.040 as the cost for one short ton. General equations are deduced for calculating the cost under different conditions; in a perfect furnace and if the line costs $2.50 per short ton, coke $2.75 and an electrical horse-power $12 at the furnace, the limiting cost of the carbide would be $8.734 per short ton; owing to the impurities of the materials and as the furnace is not theoretically perfect the minimum value would be $14.97; under favorable conditions which can be realized in peculiar localities, the total cost per short ton in a plant producing five tons a day might be $20.

Direct-Connected 1200-KW Two-Phase Alternator.

We illustrate herewith the construction of a large direct-connected polyphase alternator. Two of these machines are in highly successful

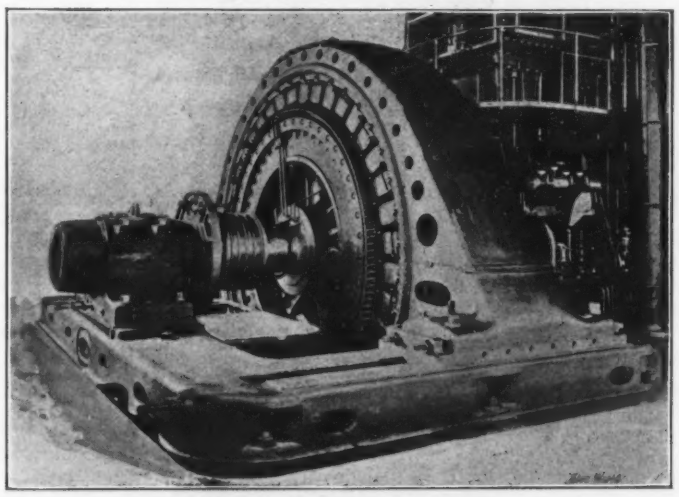


FIG. 1.—1200-KW TWO-PHASE ALTERNATOR.

operation in the plant of the Missouri Electric Light & Power Company, St. Louis, Mo. They are wound for 2200 volts, and at a speed of 180 revolutions per minute deliver two-phase currents at a frequency of 60 cycles per second, or 7200 alternations per minute. They were built by the Westinghouse Electric & Manufacturing Company, and are in every respect typical of their modern high-speed, direct-connected alternators (usually wound for a higher potential). It is thought that the accompanying reproductions illustrating the constructive features of the machine, will be of interest. A complete machine, as erected in the station of the Missouri Electric Light & Power Company, direct-connected to a triple-expansion vertical engine built by the Lake Erie Engineering Company, of Buffalo, N. Y., is shown in Fig. 1. The distinguishing feature of engine type generators is the manner of mounting the armature. As will be seen from the illustration, the armature is keyed to the engine shaft, and, revolving in the magnetic field, becomes the fly-wheel of the engine. The armature is 10 feet in diameter, and consists of a cast-iron spider, upon the outside of which a laminated steel rim is built. The spider is shown in Fig. 2, and the process of building up the steel plates, which, in the

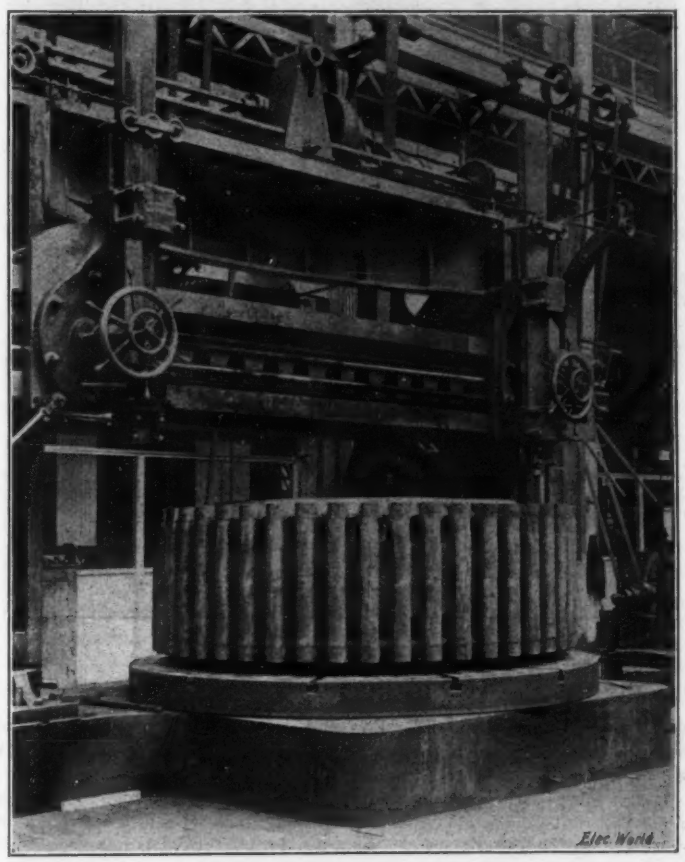


FIG. 2.—1200-KW SPIDER.

operation of the machine, are subject to alternating magnetization, is shown in Fig 3.

The completed armature core, ready for the armature conductors, is shown in Fig. 4.

It will be noted that the surface of the armature is grooved in a direction parallel to the shaft by a large number of openings, or slots, which are intersected at right angles by other openings which extend all the way around the armature. The former are prepared for the reception of the insulated conductors; the latter are provided to secure thorough venti-

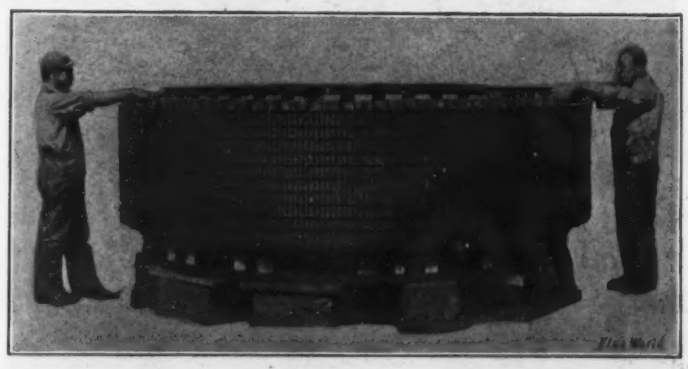


FIG. 3.—BUILDING UP 1200-KW ENGINE TYPE ARMATURE.

lation of both steel and copper, with a view to keeping the temperature so low that the insulation of the conductors cannot by any possibility be endangered.

The conductors in machines of this type are not placed in position upon the armature core until the latter has been properly put in place and keyed to the engine shaft, and the construction of both engine and generator has progressed to a point where there is little danger that the con-

ductors will be injured. The conductors are threaded through the slots from end to end, the slots being of such shape that the winding is buried beneath the surface of the armature core, which thus forms a metallic covering for the conductors. In other words, the armature is what is

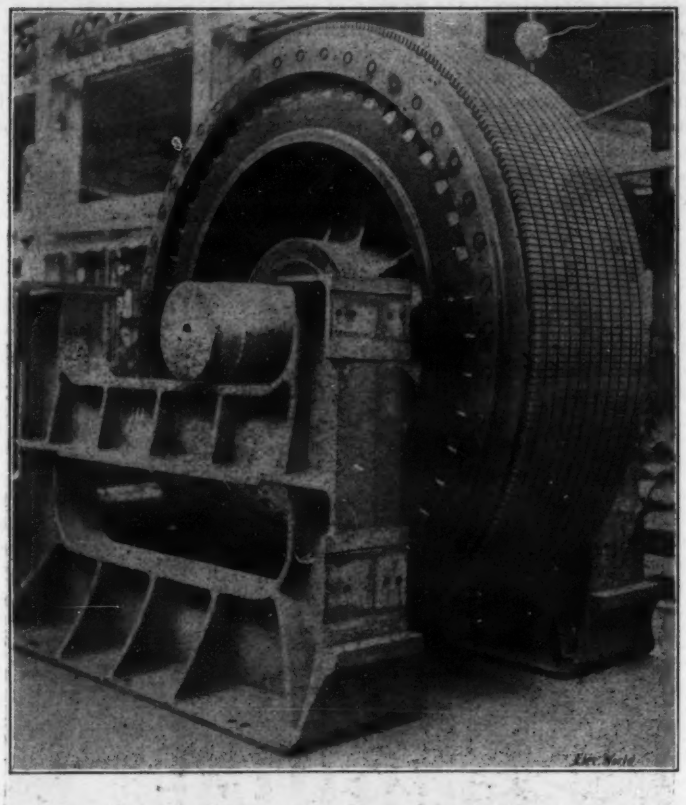


Fig. 4.—Armature Core.

commonly called "ironclad." The end connections are made by means of flat copper straps, which are so placed that they support each other against centrifugal force.

Fig. 5 shows the field castings being turned true in a lathe. It will be observed that the field is cast in two pieces, the division being in a horizontal plane, and that the lower casting is provided with massive shoulders, which rest directly upon the foundation.

The field poles of this machine are, like the armature, constructed of a great number of thin sheets of steel, punched into suitable form and cast into the yoke or frame. Each pole consists of about 1600 plates, carefully annealed before building up. These are secured together by end plates,

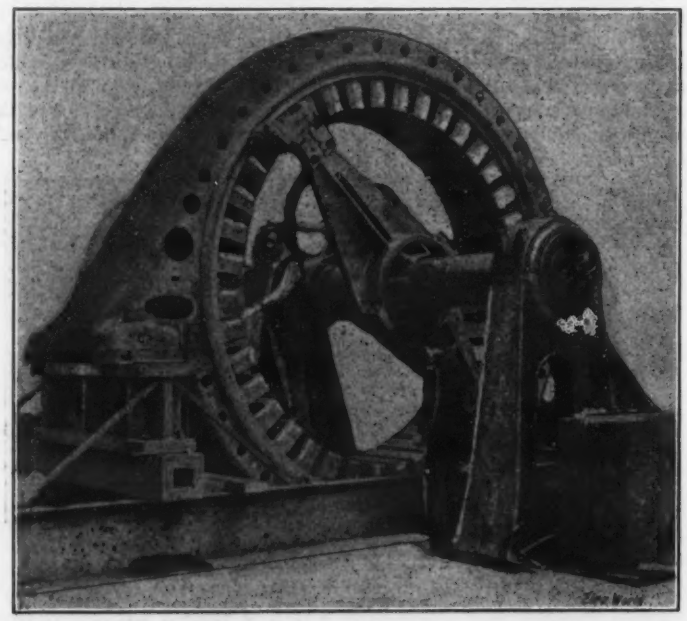


Fig. 5.—Generating Field.

which are held by long rivets passing through holes provided in the plates and the sheets of steel. It will be realized that the construction of a field in this manner requires great care in treating the plates and the highest degree of skill in the foundry. The results secured fully justify the difficulty and cost of the method of construction adopted. The magnetic field is made very powerful, the winding of the armature simplified, and the performance of the machine, as regards efficiency and regulation, greatly improved. Eddy currents, which in solid field poles are frequently set up by powerful armature currents, are prevented by the laminated structure of the poles.

The field coils are machine wound upon iron forms, which are thoroughly insulated from the winding. These forms are provided with lugs to receive the bolts, which secure them to the frame of the machine.

The collector of the machine is 29¼ inches in diameter. The bearings are 40 inches in length and 12 inches in diameter. At the bottom of the slots in the latter are the oil reservoirs, from which the oil is carried to the shaft by revolving rings, thus providing constant lubrication.

Although the practice of mounting the armature directly upon the engine shaft, and thus to a large extent combining the engine and generator in one compact machine, originated at a comparatively recent date, it is a remarkable fact that machines of this type are rapidly superseding belt-driven apparatus in large central stations.

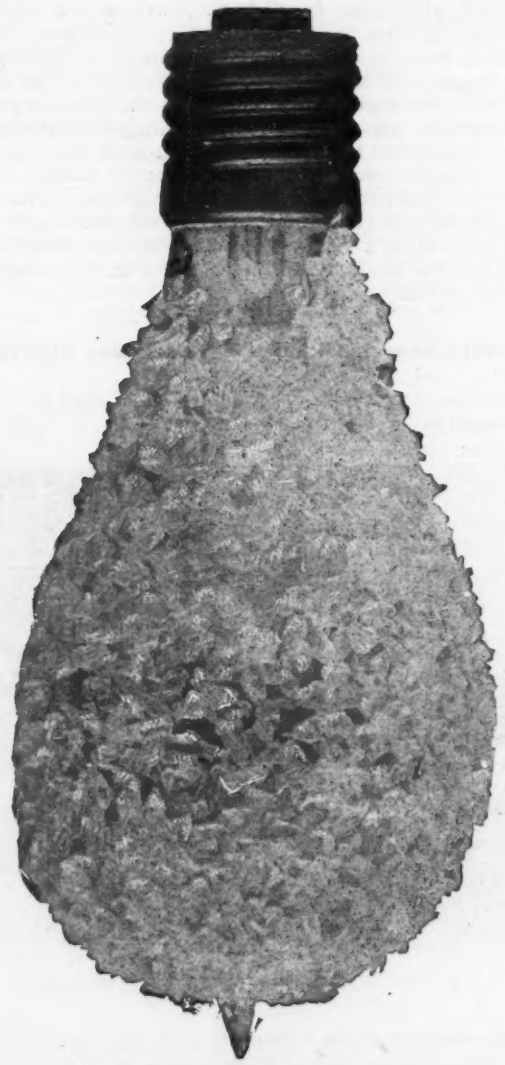
The popularity of the engine-type generators is due to their simple construction, economy of floor space, increased efficiency and decreased operating expenses.

The Patent Office Exhibit.

To ship the exhibit of the United States Patent Office of 360 models of electrical inventions for the Electrical Exposition in New York required thirty-eight cases. They weigh over two tons. Mr. W. A. Megrath, of the Patent Office, has been specially detailed by the Hon. S. T. Fisher, Acting Patent Commissioner, to take charge of the exhibit.

An Ice Lamp.

We illustrate herewith a decided novelty which should obtain popularity with users of incandescent lamps, at least during the Summer months. The entire surface of the bulb is covered with numerous facets which give an appearance of a covering of icicles. The effect is very fine, although it diminishes somewhat the intensity of the light. The preparation employed is maintained a secret, but it is stated to be unaffected by either heat or moisture. The lamp is called the "Imperial Ice Lamp," and is manufactured by the Bryan-Marsh Company, of New York City.



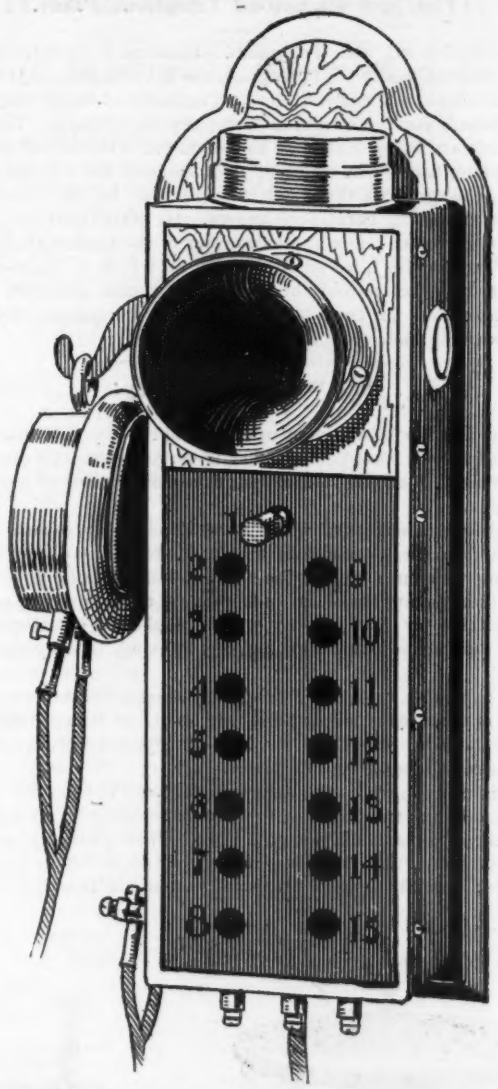
Imperial Ice Lamp.

Simplex Interior Telephone.

Telephonic communication between different parts of a building, whether the building is used for private or business purposes, is a great convenience, and the use of such instruments is very rapidly extending.

The Simplex Interior Telephone Company, 612 Johnston Building, Cincinnati, O., has an interior telephone that is especially adapted for use in warehouses, factories, stores, institutions, business offices, steamships, railway trains, hotels, residences, etc.

The accompanying illustration shows an intercommunicating instrument, with 15 connections. This cut is one half the actual size of the instrument. It is especially adapted to use in large stores, business offices, factories, warehouses, hospitals, etc., etc., in fact in all places where a means for quick local communication is desirable. In this system any one station may communicate with any other station direct, no central station being required, and any number of pairs may talk at the same time without interference.



INTERCOMMUNICATING INTERIOR TELEPHONE.

The residence telephone is used in pairs only. These instruments are simple, and can be put up by any ordinary mechanic, and the battery put in the cellar or any out of way place. They have very few moving parts, and once properly installed, need no attention other than renewal of battery when necessary.

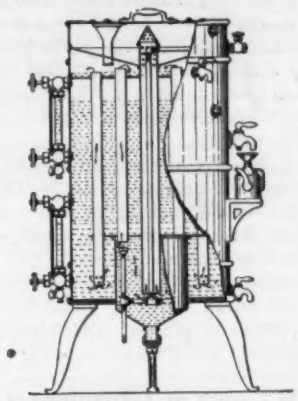
The hotel instrument can be readily attached to existing push button wires, and, in connection with the company's switching device for annunciators, makes a complete and perfect system for communication from different points to one central point, as from the various rooms in a hotel to the office.

These telephones are small and compact, and their talking qualities are said to be excellent.

Oil Purifier.

The Rival Oil Purifier, which is manufactured by F. E. Bailey & Co., Betz Building, Philadelphia, is a very effective apparatus. By its use dirty and gritty oil, which otherwise would be quite useless for a second application to machinery, is purified, cleansed, and so made fit for repeated use. The effect of this, of course, is a very large saving in annual oil bills, besides other advantages.

This purifier does not contain any filtering compound or material, such as felt, charcoal, ground cork, mineral wool, cloth, sponges, etc. It is constructed of heavy rolled galvanized iron and nicely painted and striped, being finished with handsome nickel plated or burnished brass trimmings. It stands on a substantial cast-iron base with fancy cast-iron legs, giving it a neat and attractive appearance.



APPARATUS FOR PURIFYING OIL.

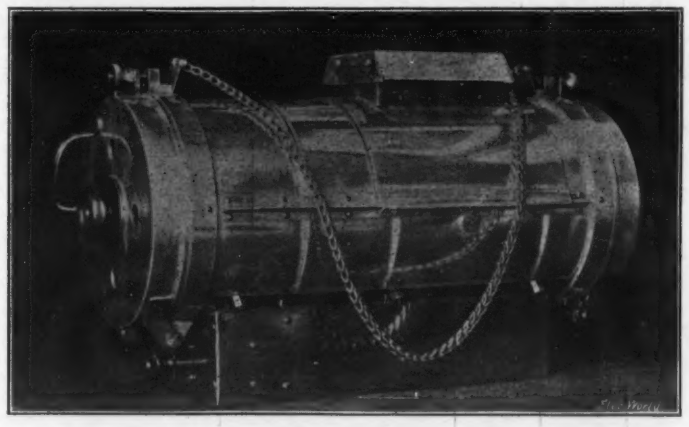
Nothing but first-class material and workmanship is employed in the manufacture of this device.

A New Searchlight.

The accompanying illustration represents a new and powerful searchlight that has just been perfected and will soon be put upon the market by the Signal & Control Company, 45 York Street, Brooklyn.

Practical tests prove that on 15 amperes of current at 45 volts, small objects, such as a spar buoy three fourths of a mile distant, can be easily made out, while sails have been seen three miles away.

Being portable, the light is packed in a box when not in use, but can be attached in less than a minute. Weighing less than 15 pounds, permits of carrying it without fatigue, or it can be suspended from a chain and operated by the officer on watch. It is provided with both automatic and hand feed, and the focusing arrangement is very simple and readily understood by any one.



SMALL PORTABLE SEARCHLIGHT.

The peculiar feature of the light is that it does not blind one when turned on and concentrates its beams upon the object desired.

Mr. A. E. Colgate is the inventor of this lamp, which is regarded with much favor by those who have seen it.

Electricity in Mines.

One of the most recent electric installations in coal mines is that by the Scranton Electrical Construction Company at the Mt. Pleasant Colliery, Scranton, Pa. The plant will consist of one four-pole 100-kw, 650-revolution 250-volt generator and one electric locomotive from the works of the General Electric Company.

The locomotive will be required to haul an average of about 400 cars daily from the counter chutes located along the main gangway; the average length of haul one way being about 3000 feet. In addition to the haulage plant the coal company will operate from the same wire several rotary coal drills in the same vein.

Electricity was selected on account of its undoubted advantages and economics in operation over any other system that could be presented.

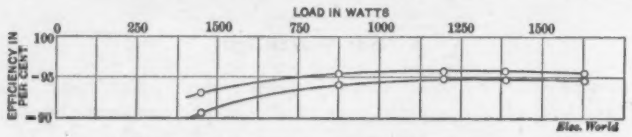
Another interesting electrical plant is being installed by the Lehigh Valley Coal Company, which operates a large number of collieries in the

anthracite district as well as many semi-bituminous mines in the Clearfield region. The plant consists of one General-Electric 150-kw 550-volt generator furnishing current to one duplex double-acting Jeansville mine pump and one 100-hp Lidgerwood friction cone-clutch single-drum hoist. Both of these machines will be set about 6000 feet from the generator in the centre of a long slope in the main coal seam. The circuit to the hoist and pump will be carried about 5300 feet above ground on a pole line and will then pass down a vertical bore-hole 350 feet deep. This part of the line will consist of an iron-armored cable, and will be suspended solely by the iron armor.

The pump will have a capacity of 600 gallons per minute, and will lift water through a vertical bore-hole to a height of 350 feet. The average work of the hoist will be the hauling of about 15 tons up an 8-degree slope at an average speed of 500 feet. The hoist will also be required to lower about five tons down the same slope. The advantages of electricity are strikingly illustrated in this plant. If electricity had not been selected for the hoist and pump work, it would have been necessary to carry the steam some distance through the mine and provide special bore-holes and condensers for the disposition of the exhaust steam.

The Choice of Transformers.

The following table shows a comparative test of alternating-current transformers, as carried out by A. H. Ford, under the direction of Prof. D. C. Jackson, at the University of Wisconsin. For these tests transformers of 1500 watts capacity, as nearly as possible, were procured directly from the manufacturers within about a year from this date, so that the tests may be presumed to represent the latest and best designs



Efficiency Curve of Transformer.

which are now supplied. These transformers are from the most prominent makers, and, in fact, include all important makes of American transformers, with two or three exceptions.

Number.	Watts Capacity.	Open Circuit Current.		Watts Iron Loss.	
		f=125	f=60	f=125	f=60
1	1250	.043	.066	37	48
2	1500	.076	.124	50	71
3	1500	.052	.100	32	46
4	2500	230	.540	135	230
5	1800	.076	.600	53	109
6	2000	.055	.091	42	56
7	1000	.028	.064	24	28
8	1500	.073	.113	57	76
9	1500	.077	.144	43	55
10	1500			31.5	44.5

Number.	Watts Copper Loss. Full Load.	Total Pressure Drop.	Efficiencies.			
			Full Load.		All Day.	
			f=125	f=60	f=125	f=60
1	30	2.5	95	94	85	83
2	45	3.5	95	94	85	81
3	38	4.0	96	95	89	85
4	44	2.5	92	89	77	68
5	67	5.0	94	92	85	75
6	55	5.0	95	94	89	86
7	33	3.0	95	94	87	86
8	31	2.5	94	93	83	79
9	28	3.0	95	95	86	84
10	37.5	3.5	95.5	94.5	89	85½

The last is the Sheefer transformer, manufactured by the Diamond Electric Company, Peoria, Ill.

In the two curves the upper shows the efficiency of this transformer at 125 periods and the lower at 60 periods.

The maximum efficiency at 125 periods, it will be seen, is 95.5 per cent., and at 60 periods it is 94.5 per cent. The iron loss is for the two frequencies, respectively 31.5 and 44.5 watts, whereas the copper loss is 37.5 watts at full load (1500 watts). The all-day efficiency, on a basis of five hours full load and 19 hours no load, is 89 per cent. and 85.5 per cent. respectively for the two frequencies. The rise of temperature after two hours full load is reported as reasonable.

The values of the iron loss which should not be exceeded in thoroughly good transformers, as determined by Prof. Jackson, are given in the following table.

Watts capacity.	Watts lost.	Watts capacity.	Watts lost.
1,000	30	4,000	80
1,500	40	6,500	100
2,000	50	17,500	150
2,500	60		

The copper losses in transformers of all sizes should never exceed 3½ per cent. at full load, and ought to be between 1½ and 2½ per cent.

The total drop in secondary pressure due to loading a transformer, if the primary pressure is kept constant, ought not to exceed 3½ per cent.

The Scheeffer transformer apparently fulfills the requirements imposed by Prof. Jackson on a thoroughly good transformer.

The New Richmond Telephone Plant.

The new Richmond, Va., Telephone Exchange is the largest independent plant thus far started. The apparatus for this exchange to the number of 2000 telephones and switchboard capacity is being supplied by the Western Telephone Construction Company of Chicago. The new multiple switchboard being furnished to Richmond is the latest improvement in modern telephony. Mr. Keelyn, who designed the system, states that for large exchange work these switchboards will be the most rapid and effective of anything heretofore known. He states that no more movements are required to reach any subscriber in the system than is required with the Western No. 1, for small exchanges, which is claimed to be the most rapid and effective switchboard yet put into practice. The Richmond contract is 25 per cent. larger than any heretofore closed by the independent telephone companies for apparatus.

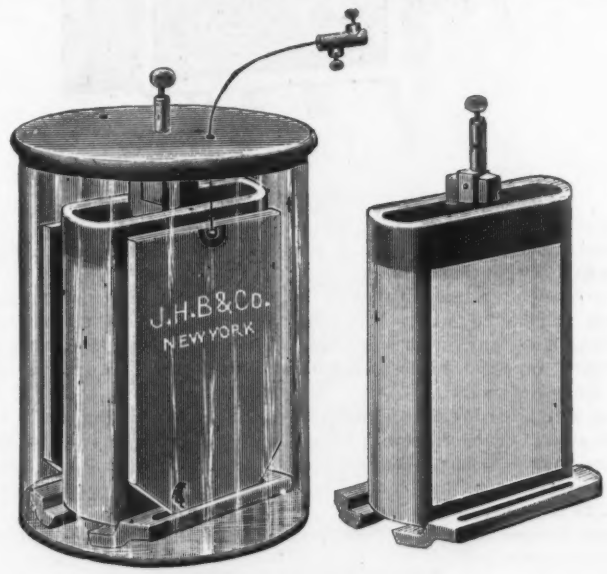
The Wheelock Battery.

A primary battery is being put upon the market by J. H. Bunnell & Co., 76 Cortlandt Street, New York, which is very powerful on open or closed circuit work and does not polarize under severe strains or heavy work on short circuits.

It is a simply constructed battery and produces economically a large current which renders it especially valuable for the operation of motors, fans, sewing machines, dental tools, small boat propellers, phonographs, etc. It is likewise applicable to such uses as the operation of induction coils, especially for Röntgen-ray work, telephones, electroplating, temporary arc and incandescent lighting, gas lighting, railway signals, power bells, etc.

A cell 6 x 8 inches in size has a capacity of 100 ampere-hours, delivering from 2 to 15 amperes of current for any length of time within its limits without polarizing under the strain. On open-circuit work it stands ready always to develop its full power.

The zincs are flat and self-amalgamating, and the porous cup is especially prepared and treated so as to be indestructible in strong acids and give perfect action as a diaphragm. The carbon plates are small and of the common kind, and the glass jar is of the ordinary pattern. The acid solution consists of sulphuric acid, chromic salts and water, and the



Improved Primary Battery.

exceptional depolarizing results are obtained by the combination of the solutions, diaphragm, and the inverted T carbon plate permanently set in the porous cup.

The Wheelock battery is said to embody all of the most valuable features of the Fuller, Bunsen, Grove and other batteries of that class, and it is recommended as one of very high efficiency and reliable in its duty.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, April 25, 1896.

GENERAL ELECTRIC.—The report of the General Electric Company had no marked effect on the stock, the price remaining practically steady throughout the week. Quotations fluctuated within a narrow margin, the highest price being 37⅜, and the lowest 37⅛, closing at 37⅜. The net result for the week was a decline of ⅛.

AMERICAN BELL TELEPHONE shows an advance of one point at the close of the week, as compared with the price at the close of the week previous.

WESTERN UNION gained two points during the week, closing at 86½.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	97	98½
" " " Brooklyn	100	100	102½
" " " Boston	100	135	140
" " " Philadelphia	100	131	131¼
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	34¼	34¾
Electric Storage, pref	100	35½	36
General Electric	100	37⅛	37⅜
General Electric, pref	100	75	78
Westinghouse Consolidated, com	50	29½	30
" " pref	50	53	54
BONDS.			
Edison Electric Ill., New York	105	103¼	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	92
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	205	206
American District Telegraph	100	33	40
American Telegraph & Cable	100	94	97
Central & South American Telegraph	100	124	127
Commercial Cables	100	158	..
Erie Telephone	100	60	60½
New England Telephone	100	..	90
Postal Telegraph-Cable	100	87	87¼
Western Union Telegraph	100	86⅜	86½
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18¾	18⅞
Brooklyn Rapid Transit		25	25⅛
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	73	75
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	..	49
Hestonville	100	47½	47¾
" pref		..	62½
New Orleans Traction	100	15	17
" " pref	100	61	65
North Shore Traction	100	30	32
" " pref	100	80	82
Rochester St. Ry	..	..	30
Steinway, Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	14½	14¾
West End, Boston	100	71¼	71¾
" " pref	100	90	..
Worcester Traction	100	17	19
" " pref	100	87	90
BONDS.			
Brooklyn Rapid Transit 5s. 1945	100	76	79
Buffalo St. Ry. 1st con. 5s	100	105	107
Cleveland Elec. Ry. 1st mtge 5s	100	100	103
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	99½	102
Union Railway (Huckleberry) 1st mtge 5s		102½	105
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

TRACTIONS.—Brooklyn City Railway stock was the strongest, if not the most active security in the street railway list during the week. The stock opened at about 167, and advanced to 170½. Various reasons are ascribed for this advance, among them being the approaching warm weather, and consequent heavier travel, and the probable arrangement for the distribution of express matter by the cars.

THE DIRECTORS OF THE DAVIS & EGAN MACHINE TOOL COMPANY held its regular quarterly meeting Monday and declared a dividend of 3 per cent. for the first three months of the year. This is one of Cincinnati's solid institutions, and has no outstanding bonds, preferred stock or other indebtedness. The company is now working full time, and are making arrangements to largely increase its capacity.

FINANCIAL REPORT OF THE GENERAL ELECTRIC COMPANY.

The following is the report of the financial operations of the General Electric Company, for the year ending Jan. 31, 1896.

SCHENECTADY, N. Y., April 18, 1896.

C. A. COFFIN, Esq., President General Electric Company.

Sir:—The balance sheet and statement of profit and loss, herewith transmitted, include the assets and liabilities and profit and loss accounts of the Edison General Electric, Edison Electric Light, and Thomson-Houston Electric Companies (which, for convenience of book-keeping, are consolidated with those of the General Electric Company) at Jan. 31, 1896; and when "the company" is spoken of in the following explanations, all the above-mentioned corporations are included.

It may be here stated that all losses have been written off as soon as ascertained, and that no anticipated profits have been taken into account.

ASSETS.

PATENTS AND FRANCHISES.

Previous annual reports carried these at		$8,159,264 02
During the year there was expended for: Capitalizing future royalties, patent litigation expenses and acquiring new patents	433,361 02	
Total patent account at end of year	8,592,625 04	
Now written off to Profit and Loss	592,625 04	
Leaving the patents, franchises, good will, etc. of the company standing on its books at the date of this report		$8,000,000 00

Future royalties were capitalized by cash payments which might properly be carried in a suspense account and charged off, from time to time, as the goods subject to the royalties are shipped; but the entire amount has been written off to the year's profit and loss. They were as follows:

I. All future payments to the estate of Charles J. Van Depoele, under contracts with the Thomson-Houston Companies to pay royalties during the life of the Van Depoele patents—a future period of approximately 15 years.

II. All obligations to make further payments upon the Henry railway patents, under contracts between John C. Henry and the Thomson-Electric Company, and a license to use those patents without payment of future royalties.

The above settlements cover full release to the company and its allied companies from all claims to date.

III. A full settlement with Mr. Edison of all claims, under his contracts with the Edison Companies, against the company or any of its allied companies.

FACTORY PLANTS.

This account represents the lands, buildings, machinery, tools, appliances, etc., of the factories at Schenectady, N. Y.; Lynn, Mass., and Harrison, N. J.

The real estate amounts to over 70 acres, and the total factory floor space of all three factories is approximately 1,350,000 square feet. All are free from mortgage or other lien.

These plants being a permanent investment, all expenditures for their maintenance and repairs are charged to operating expenses. The cost of all additions to the plants has been more than offset by regular allowances, charged monthly to operating expenses, to provide for all depreciations. In addition, large reductions have been made at the close of each fiscal year, for the purpose of writing this account down to replacement value, and this end is now accomplished.

The book value of these three plants at Jan. 31, 1893, the date of the first annual report, was (see below) $3,958,528 21

A summary of the changes in this account since then is worthy of attention.

	Cost of Additions.	Written Off for Depreciation.
*Lands and buildings	$288,581 00	$231,487 64
Machinery and tools	999,347 77	1,003,855 21
Patterns and drawings	177,644 23	447,876 64
Sundry accounts	48,631 61	321,511 33
Totals	$1,514,204 61	$2,004,730 82

Amount written off in three years, over and above all maintenance, repairs and additions	490,526 21
Book value of factory plants at Jan. 31, 1896	$3,468,002 00

The above additions represent cash expenditures, and provided about 35 per cent. increased capacity of output.

All depreciations have been written off to Profit and Loss.

Summaries of Factory Plants.

	—FOR EACH PLANT.— Jan. 31, 1893.	Jan. 31, 1896.
Schenectady factory	$2,215,364 17	$2,135,000 90
Lynn factory	1,280,980 12	1,038,000 80
Lamp factory	462,183 92	295,000 30
Totals	$3,958,528 21	$3,468,002 00

* Includes $20,000 paid for about five acres of land acquired by the Schenectady factory, whose real estate now amounts to nearly 44 acres.

	—For all three Plants.— Jan. 31, 1893.	Jan. 31, 1896.
Lands and buildings	$1,742,906 64	$1,800,000 00
Machinery and tools	1,672,507 44	1,668,000 00
Patterns and drawings	270,233 41	1 00
*Sundry accounts	272,880 72	1 00
Totals	$3,958,528 21	$3,468,002 00

REAL ESTATE.

(*Other Than Factory Plants.*)

Exclusive of the investment in the Edison Building, 44 Broad Street, New York City, this account represents sundry pieces of real estate, mostly improved and rented, taken at various times, chiefly in payment of debts. All can be sold without detriment to the business of the company, when opportunity offers.

During the year a large factory covering five lots on the corner of Avenue B and Seventeenth Street, New York City, was acquired from the General Fixture Company in part payment of a debt.

STOCKS AND BONDS.

In Schedule A, annexed hereto, are described the company's stocks and bonds.

Those having a market value are carried at slightly under the price of recent sales. The book value of those not readily saleable have been fixed after making inquiries of the officers of those companies, and of banks and others in the cities where the properties are situated.

I believe the aggregate book value of these stocks and bonds is not in excess of their present value.

Included in Schedule A are stocks and bonds of various companies, amounting to $2,897,103.30, at par. The present value of these is doubtful and their future value speculative. They are, therefore, carried at a total book value of only $96, being $1 for each lot; but it is not unlikely that in time a considerable amount may be realized from them, as the amount realized during the year from sales of securities similarly valued was $41,646.77.

There are also stocks of 24 underlying and other manufacturing, selling and patent owning corporations of a total par value of $40,654,900, which must be held until those corporations are dissolved. They, too, are carried at $1 for each lot, in all $24—the difference between this sum and their original cost being carried in the patent account or written off in Profit and Loss. Included in these is the company's entire holdings of stock of the Brush Electric Company, of Cleveland, which were carried last year at $351,506.63.

NOTES AND ACCOUNTS RECEIVABLE.

The face of notes and accounts receivable at the date of the first annual report was about $16,000,000. During three years of persistent work the collection of this debt has progressed as satisfactorily as was possible under the circumstances, and another year will probably result in the conclusive liquidation of most of the remaining old indebtedness.

There was included in the debit balance to Profit and Loss at the end of the last fiscal year an allowance (for estimated depreciation on specific notes, accounts and local lighting and street railway properties owned) amounting to		$2,457,625 98
Of this there has been used in effecting settlements during the year		1,419,576 36
Balance of such allowance remaining before closing the books		$1,038,049 62
Some old matters were not sufficiently depreciated, and for these there is now added to the above a further allowance of	$152,882 79	
An allowance is also added for possible losses on new business	216,346 79	
		369,229 58
Specific allowance now standing to provide for losses on notes, accounts and local properties owned		$1,407,279 20
The amount realized over and above their book values on all depreciated notes, accounts, etc., during the year was		$473,458 68
The depreciation has been increased, as above		369,229 58
Over-allowance last year		$104,229 10

The total amount now due the company by customers is as follows:

	Face Values.	Face Values.
Current notes	$1,522,178 46	
" accounts	2,910,443 41	
		$4,432,621 87
Old debts which are being liquidated as speedily as possible—not including "dollar" notes and accounts:		
Notes	$1,371,561 59	
Accounts	494,176 70	
		1,865,738 29
Due from local lighting and street railway properties owned by the company		516,304 65
New Orleans investment		1,431,469 83
The Brush Electric Company		479,755 78
"Dollar" notes and accounts		2,432,860 88
Total face value		$11,158,751 30

All are carried in the balance sheet at a value of $6,584,123.30. I believe this estimate of their realizable value is a fair one.

The above total of $11,158,751.30 is divided between notes receivable and accounts receivable, as follows:

Notes Receivable.—There are on hand notes of 312 makers, of which there are only 58 makers of notes for $10,000, and over.

They are classified as follows:

Good Notes:	Face Values.	Face Values.	Book Values.
Short date, active	$663,515 33		
Long date, slow	858,663 13		
		$1,522,178 46	
Old Notes		$1,371,561 59	
Total		$2,893,740 05	
All these notes are carried at a book value of			$2,107,168 69

Accounts Receivable.—What are described above as current accounts comprise about 4,000 debit balances, mostly for comparatively small amounts against customers who make monthly settlements. The exceptions are for large contracts, final payments on which are not yet due. Including these there are but 108 customers owing in excess of $5000 each, on open account.

The accounts receivable are classified as follows:

	Face Values.	
New Orleans investment	$1,431,469 83	
The Brush Electric Company	479,755 78	
Sundry debtors:		
Current matters	2,910,443 41	
Old matters	494,176 70	
Total	$5,315,845 72	
All these accounts are carried at a book value of		4,122,743 19

Local Properties Owned.—From various causes, principally taking over the properties for debts, the company owns twenty concerns operating central station lighting plants and street railways. The total face amount due the company on open account from such concerns is $516,304.65.†

These accounts are carried at a book value of 353,775 42

"Dollar" Notes and Accounts.—Old notes and accounts receivable of 436 debtors (whose face indebtedness aggregates $2,432,860.88) which have all been written off to Profit and Loss except the nominal book value of $1 for each debtor. They will be liquidated as rapidly as possible.

These are carried at a total book value of 436 00

Total amount of book value $6,584,123.30

Summary.—Total appraised or book value of all notes and accounts receivable as shown on the balance sheet.. $6,584,123 30.

Allowance for possible losses:

On notes, accounts and local properties owned	$1,407,279.20	
On "Dollar" notes and accounts	2,432,424.88	
Half of special allowance	734,923 92	
		4,574,628 00
Total face value as above		$11,158,751 30

New Orleans Investment.—Arrangements have been made to sell the company's claim filed with the receivers of the Fort Wayne Electric Company, mentioned in the last annual report, and to receive in payment therefor various securities of the Louisiana Electric Light and Edison Electric Companies of New Orleans.

The effect of this exchange is to acquire, in lieu of an unproductive debt of uncertain value, an investment which may ultimately yield a fair return.

In addition to such securities received for the Fort Wayne account, other securities of those companies have been purchased with cash.

CASH.

It has not been necessary to borrow money, nor has the company's credit been used during the year, either by issuing notes, endorsing customers' paper for discount, or lending its name in any way to allied companies or others.

The average cash balance during the year has been $578,000, and all purchases during the year have been paid for in cash.

Collections.—The losses actually incurred through bad debts on business taken during the year have been few and unimportant; but to provide against possible losses, rebates, etc., on uncollected accounts and notes of the year's business an allowance of $216,346.79 has been made.

Excluding all cash received for notes which matured during the year, and excluding also all renewal notes—the collections from customers on accounts receivable and on account of contracts ("Work in Progress") were as follows:

		Per centage.
Cash	$11,005,220 26	83.57
Notes	1,888,106 80	14.34
Securities (par)	275,637 50	2.09
Total	$13,168,964 56	100.

Under some old contracts, securities were taken from customers in part payment of apparatus delivered during the year, as follows:

	Par Value.
Bonds (majority since sold for future delivery)	$259,000 00
Stocks	16,637 50
Total	$275,637 50

Sales of Assets.—Pursuant to the policy announced in previous annual reports, various securities and other assets, which it was not desirable to hold permanently, have been sold during the year. The cash thus received was placed in a special fund, and together with about $300,000 additional money obtained from the collection of old notes and accounts, was expended to protect and improve existing investments, about $450,000 being used in connection with the New Orleans investment. None of the money realized from the sale of assets was required for the current business of the company during the year.

The following statement shows the result of securities sold:

* Include office furniture, horses and trucks, shop fixtures, benches, steam fitting for heating system, etc., etc.

† In addition to this indebtedness the company holds securities of these local properties as follows:

Stocks, par value	$377,000,	Book value	$78,680 72
Bonds; par value	89,000,	Book value	30,501 00
	$466,000,		$109,181 72

Par Value.	Book Value.	Sold For.	
$783,490 00	$467,858 50	$627,277 53	$159,419 03 Profit.
423,710 00	6 00*	41,646 77	41,640 77 "
152,620 00	46,189 19	38,475 16	7,714 03 Loss.
$1,359,820 00	$514,053 69	$707,399 46	$193,345 77 Profit.

* Carried at $1 for each lot.

Besides stocks and bonds, the principal asset sold was the Schuyler factory at Middletown, Conn.

WORK IN PROGRESS.

This account represents expenditures to date for labor, material, etc , on 285 installations in progress		$1,406,261 77
Less partial payments thereon, received under the terms of the contracts as work progressed		444,875 39
Balance		$961,386 38

None of the estimated profit to be derived from these installations is included in the year's profit and loss.

INVENTORIES.

These accounts represent raw materials and goods manufactured and in process of manufacture at the factories; manufactured goods in storerooms of local offices and on consignment; office furniture, etc., in the general office and in all local offices; tools and materials in local repair shops, and also shipments in transit to local storerooms. All have been counted and valued item by item.

At Factories.—The raw materials on hand are commodities not liable to violent fluctuations in value.

The amount of material in process and finished apparatus on hand is the average amount required for current needs, and represents about four months' output, which is not excessive at this time of year, considering the nature of the business.

Raw materials have been valued at the market prices prevailing on Jan. 31, 1896; partly finished apparatus at cost of labor and material; active selling finished apparatus at factory cost; inactive or slow selling apparatus at not over 50 per cent. of factory cost; and obsolete apparatus at scrap value.

At Local Offices.—All furniture, fixtures, tools and instruments of the general office and of all local offices and repair shops are included here.

The finished apparatus and supplies in the different local storerooms of the Company were classified into active, inactive and obsolete stock. Active stock is inventoried at factory cost; inactive stock, *i. e.*, all apparatus and supplies which have depreciated in market value and are slow selling, but which have a saleable value, at 50 per cent. to 75 per cent of factory cost; and obsolete stock at scrap value.

Figured on the above basis these inventories showed a shrinkage of $101,191.43, which has been written off as a loss for the year.

Goods are taken in and out of local office inventories at factory cost, and the bulk of the above shrinkage is due to factory costs at Jan. 31, 1896, being lower than at Jan. 31, 1895, and the remainder to writing down slow-selling apparatus.

Consignments.—Finished apparatus for novel uses has been delivered to various concerns subject to purchase if its operation is successful. The greater part of this account represents such contingent sales, and the remainder represents apparatus being exhibited in public expositions or loaned to regular customers for temporary use by them.

All the above apparatus is charged to this account at factory cost at a total of	$129,906 71
On which there is an allowance for depreciation by use of	43.136 46
Net book value of consignments	$86,770 25

LIABILITIES.

The company has no note payable outstanding, nor is any paper bearing the company's endorsement under discount.

ACCRUED INTEREST ON DEBENTURES.

This account, as its name implies, is the full amount of interest accrued to Jan. 31, 1896, on the company's $8,750,000 outstanding 5 per cent. gold coupon debentures.

ACCOUNTS PAYABLE.

This account includes all unpaid audited indebtedness.

At the close of business on Jan. 31, 1896, when the cash was $879,685.75, the unpaid vouchers on hand amounted to only $24,248.30, and none of these was due under the terms of purchase.

The amount of accounts payable shown in the balance sheet, $428,152.78, represents expenditures, belonging to the year, vouchered between Jan. 31 and March 10, the date of closing the general books. The amount of vouchers which have to be carried over in this way monthly, owing to keeping the books—other than the cash book—open a sufficient time to include expenditures of a particular month in that month, is usually about $500,000.

PROFIT AND LOSS.

LIQUIDATION OF OLD MATTERS.

The cost of the year's liquidation of old matters was		$524,209 82
Additional allowances for depreciation on notes, accounts, etc.		369,229 58
Writing down the entire holdings of the stock of the Brush Electric Company to the nominal value of one dollar		351.505 63
Appreciation of total book value of all stocks and bonds, upon reappraisal at Jan. 31, 1896.	$47,988 42	$1,244,945.03
Profit on settlements of old notes, accounts, etc.	473.458 68	
Profits on sales of stocks and bonds	193,345 77	
		714,792 87
Net loss on liquidation, now charged to the special allowance of Jan. 31, 1895		$530,152 16

BUSINESS OF THE YEAR.

Gross earnings		$13.315,667 12
Gross expenses		11,910,240 26
		$1,405,426 86
Deduct		
Interest on debentures	$437,500 00	
Less interest and discount, and interest and dividends received on securities owned.	421,040 60	16,459 40
Profit		$1,388,967 46
Deduct amounts written off.		
Patents and franchises	$159,264 02	
Factory plants	322,339 43	
Other real estate	29,718 52	
		511,321 97
Reduction of the deficit of previous years		$877,645 49

ALLLOWANCE FOR POSSIBLE LOSSES.

In addition to the specific allowance for losses on notes, accounts and local properties owned	$1,407,279.20
and to the allowance for depreciation on consignments there remains standing in profit and loss the unused balance of the $2,000,000 special allowance made arbitrarily at the end of the last fiscal year to take care of old obligations and possible losses, viz:	43,136.46
	† 1,469,847.84
Making a reserve or guarantee fund (included in the deficit) of	$2,920,263 50

Respectfully submitted,
J. P. ORD, *Second Vice-President.*

† One half of last year's special allowance was then arbitrarily deducted from the book values of notes and accounts receivable and local plants owned, and one half from the book value of stocks and bonds. This $1,469,847.84 is similarly apportioned this year.

CONSOLIDATED BALANCE SHEET OF JAN. 31, 1896.

Assets.

Patents and franchises			$8,000,000 00
Factory Plants			3,468,002 00
Real Estate (other than factory plants):			
Edison Building, New York City	$412.584 63		
Less mortgage thereon	200,000 00		
	212,584 63		
Other real estate	241,000 00	$453.584 63	
Stocks and bonds (see Schedule A)		5,479,332 23	
Notes and accounts receivable		6,584,123 30	
			12,517,040 16
Cash			879,685 75
Work in progress		961,386 38	
Inventories:			
At factories	3,418,572 60		
At local offices	714,540 81		
Consignments	86,770 25		
		4,219,883 66	5,181,270 04
Profit and loss			13,917,071 48
			$43,963,069 43

Liabilities.

Capital Stock:		
Common	$30,460,000 00	
Preferred	4,252,000 00	
		$34.712.000 00
Five per cent. gold coupon debentures		8,750,000 00
Accrued interest on debentures	72,916 65	
Accounts payable	428,152 78	
		501,069 43
		$43,963,069 43

The annual meeting of the stockholders of the General Electric Company will be held at the company's office, Schenectady, N. Y., on Tuesday, May 12, at noon.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, April 27, 1896.

MESSRS. DALE, FARRELL & CO. have moved their offices from 70 Trinity Place to the American Tract Society Building, corner Nassau and Spruce Streets.

H. J. MEDBURY, president of the Fiberite Company, Mechanicville, N. Y., has been spending a few days in New York in the interests of the well-known specialties of his company.

THE OKONITE COMPANY, LIMITED, will remove on May 1 from its present offices in Park Row to Rooms 412, 413 and 414 Postal Telegraph Building, 253 Broadway, New York.

THE SPENCER ELECTRICAL COMPANY, 163 Greenwich Street, is manufacturing telephones for exchanges, offices, factories, buildings, etc. The system is a new one, and the instruments are of high-grade construction and material. A little pamphlet published by the company describes the apparatus.

NEW TIMBER.—Mr. William Arnot, Mr. Michael Duffy and Mr. John McKenna, well-known underground cable experts, have resigned from the Standard Underground Cable Company, and have made arrangements with the National Underground Cable Company. Each of these men has had a long experience in undergound and aerial cable construction work of all kinds.

FIRE.—The manufacturing plant at Cranford, N. J., of the Law Battery Company, 39 and 41 Cortlandt Street. was burned on the night of April 17, the loss being practically total. All the stock was destroyed, but the company will be in a position to fill orders in a week or so. The fire originated outside of the building, starting in some unknown way. A new building, of iron, will be erected on the site of the one burned.

MARRIED.—Miss Edna Earle Johnson, daughter of Mr. and Mrs. E. H. Johnson, was married in St. Agnes' Protestant Episcopal Chapel, in West Ninety-second Street, this city, on April 22, to Mr. George Quintard Palmer. The ceremony was performed by Bishop Quintard, of Tennessee, uncle of the bridegroom. The bride's sister, Miss Lilian Johnson, acted as maid of honor, and Frank Fletcher Palmer, brother of the bridegroom, was the best man.

UNDERGROUND CABLE TERMINALS.—The National Underground Cable Company, of New York, Boston, Philadelphia and Chicago, has just organized a new department for the sole manufacture of Reid tubular terminal heads for electric light and street railway feeder cables and telephone and telegraph cables, which will be under the immediate supervision of Mr. Edwin S. Reid, the inventor. More than 100,000 Reid terminals are in use to-day in the United States and Canada on underground and aerial cables.

New England Notes.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., April 25, 1896.

THE PETTINGELL-ANDREWS COMPANY, Boston, will be represented at the Convention-Exposition, in New York, and will circulate a very handsome pocket edition of the latest rules and requirements of the National Board of Fire Underwriters, very well indexed. This is an idea of General Manager C. B. Price, and it will undoubtedly be greatly appreciated.

THE NATIONAL PIPE-BENDING COMPANY, New Haven, Conn., has just issued an attractive illustrated lithographic hanger representative of its handsome factory, feed-water heater and coil, the background of which presents a well-executed view of New Haven Harbor, at the point of its business location. It is in every respect a creditable production that will undoubtedly receive conspicuous preservation in electric and power plants, business offices and factories, and is a fitting celebration of the enviable record of 700,000 horsepower of National feed water heaters now in use.

ELECTRIC POTENTIAL.—The annual meeting and election of officers of this organization was held last Wednesday evening at the Hotel Thorndike, Boston, and was of particular interest in that ladies graced the occasion and Prof. Elihu Thomson was the guest and lecturer. About 100 ladies and gentlemen were present. Previous to the dinner a brief business meeting was held, several new members were admitted, and the following officers were elected for the ensuing year: President, Frank Ridlon; vice-Presidents, Geo. W. Blodgett and H. F. Woods; secretary, Sidney Hosmer; treasurer, I. H. Farnham, all of whom are re-elected, with the exception of Vice-President Woods, of the West End Railway Company. Col. E. H. Hewins, who has served as vice-president during the year just closed, and who by rotation was entitled to the presidency, was nominated for that position but declined out of compliment to Mr. Ridlon, who was unanimously re-elected. Mr. Ridlon will continue the same hard and effective work, and the Electric Potential will undoubtedly continue its advance and prosperity under his direction.

THE ELECTRIC STORAGE BATTERY COMPANY closed recently through its New England office, a contract with the Hartford (Conn.) Electric Light Company for a battery which will be, when completed, the largest individual installation in America. The battery will have a capacity, when completely installed, of about 2500 horse-power for about one hour. The object of the battery is to take the peak of the load of the Hartford Company, and will operate on the three-wire Edison system. The battery will be charged from the Farmington River Company's station, which is 11 miles distant. The turbines will drive alternating-current generators, giving a voltage of about 2500, which will be raised to 10,000 volts by a bank of transformers. The current will be transmitted from this bank of transformers over 11 miles of line, using copper wire, and on reaching the limits of the town the voltage will be reduced to 2000 volts. Part of this supply will be used upon the alternating-current system of the Hartford Company, and the other part will be passed through reducing transformers receiving alternating current and giving out a direct current, the direct current being used to charge the batteries. The whole arrangement laid out and contracted for will be the most flexible one ever installed, as it will be able to operate alternating current or direct current for lamps, motors (alternating and direct) of several voltages. The work of installing this huge battery will begin within 60 days, and it is hoped that the complete installation will be finished before the heavy lighting of the Autumn. Mr. Arthur E. Childs, New England manager of the Electric Storage Battery Company, is certainly securing some important victories, and there are others yet to come.

REORGANIZATION.—The reorganization of the W. S. Hill Electric Company has been completed and a new corporation under the laws of Massachusetts, with $70,000, full paid capital, takes the place of the old company. The business of the new company will be located at New Bedford, Mass, about the first of May, in a substantial brick factory with a 50-hp steam engine and boiler, which will be equipped with all the facilities that will be required to enable it to manufacture its goods to the best possible advantage. The company will continue to maintain an office in Boston, at 141 Franklin Street, in charge of Mr. Louis E. Hill, who has earned an enviable reputation through manifest abilities in association with his father. It will be the aim of the new company to maintain the present high reputation of the Hill goods—switches, switchboards and special electrical machinery—and to market them at prices that will ensure a very large increase in the output of the factory. This organization is a matter of congratulation to the many friends of Mr. Warren S. Hill, whose connection with the electrical business is contemporaneous with the first commercial applications and who has all along been conspicuously identified with so many of the important advancements, and who richly deserves in every respect the reward of his honest and indefatigable labor which this new company promises to bring to him. Its stockholders and board of directors comprise some of the most influential and strongest business and financial men of New Bedford. Mr. Chas. S. Mendell, secretary and general manager of the new company, served his apprenticeship with Mr. Hill. He has had extended electrical experience, is well and favorably known in New Bedford, through his connection with its electric railway, gaining thereby the confidence of its citizens and particularly of the gentlemen who have identified themselves with the new Hill Company, and brings to it several new and important inventions in the line of street railway apparatus, which will form a part of future manufacture.

Washington Notes.

WASHINGTON, D. C., April 24, 1896.

THE GOVERNMENT, through the office of the District Commissioners, is inviting proposals until May 7, for supplies for the various buildings of the district.

THE EXPORT LIST of the last fiscal year, of lamps, chandeliers and all devices and appliances for illuminating purposes, amounted to $669,777, the largest consignments going to the United Kingdom, Dominion of Canada, and British Australasia.

THE NICARAGUA CANAL and the Hawaiian cable questions were considered by the House Committee on Commerce, but no votes were taken on any of the bills. The discussion over the Pacific cable question was a very warm one. Two companies, the Pacific Cable Company of New Jersey, and the Pacific Cable Company of New York, are each making efforts to secure the Government endorsement. Each company has very strong partisans in the committee, and it is possible the matter may end in a deadlock, which so far as this Congress is concerned will defeat the cable project entirely. It has developed in the course of the discussion that Mr. J. Pierpont Morgan is, with Mr. James L. Scrymser, the chief stockholder in the Pacific Cable Company of New York. Mr. Scrymser is president of the cable company which operates the cable to Cuba and the West Indies, under an exclusive concession granted by Congress several years ago. Prominent among the stockholders of the company are Sol. Spaulding, of Honolulu, Abram S. Hewitt, D. Ogden Mills, Frederick D. Grant, Gen. Wager Swayne, of New York, and J. J. Hill, of St. Paul. This company has secured from the Hawaiian Government a concession giving the sole right to operate a cable between the islands of the Hawaiian group. The Scrymser company expects to make its landing at Pearl Island Harbor, where the United States have a naval station, through an arrangement with the Hawaiian Government. The personnel of the two companies insures their ability to carry out any contract they may enter into with the United States, and the committee, members of it say, would be well satisfied with either, if the other were not in the field. Considerable interest is taken in the progress of negotiations by the Hawaiian Legation, and its representative is present at all the hearings. A resolution was adopted by a vote of 10 to 4 expressing the sense of the committee to be that the Government should aid by a subsidy the construction of a Pacific cable. Neither of the two rival companies were named in the resolution, and no terms were suggested.

THE HOUSE DISTRICT COMMITTEE gave a hearing this week on the proposed westward extension of the Columbia and Capital Traction railway companies, both seeking to use practically the same route. This is one of the most important hearings of the kind during this session and a number of prominent people were present. The bill under consideration allows the Columbia line to extend its double tracks from the present terminus at Fifteenth Street and New York Avenue along a given route, with authority to move and propel its cars on the line so constructed with an underground electric power, or such other mechanical power as the commissioners of the District of Columbia may approve. The National Capital Traction Company desires to use their own tracks to Seventh Street and extend them over the same route. Mr. Wilson spoke in favor of the Columbia's proposed extension, and said it was what the company had been asking for the past four or five years. The company was always given to understand that the Washington & Georgetown road made no objection except on the ground that the running of horse cars over a portion of their lines would seriously interfere with their business. The territory then seemed to be a matter of no consequence. As a result of such understanding, the Columbia people borrowed $500,000 and put in a cable system, so as to obviate this objection. Now the route had been changed so as not to enter upon the tracks of the National Capital Traction Company, but they still persist in objecting. Mr. Wilson called attention to the exhaustive hearings previously given on the subject, and which finally resulted in a favorable report being made last year after a prolonged contest, authorizing the Columbia to make the extension. He called attention to the old suggestion that the Traction Company run its cars directly down Fourteenth Street to Pennsylvania Avenue. Several hundred people living along the line of the proposed extension had petitioned for its construction, on the ground that the road would be more advantageous to them than the Traction line, which did not extend at all into the eastern portion of the city. "It is the greatest desire of every American citizen," said Mr. Wilson, "to get to the United States Treasury by the shortest route, and would not be directed therefrom." Some 1300 heads of families signed a petition for the Columbia extension, while but 200 indorsed the Capital Traction extension.

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., April 24, 1896.

RICHARD THOMAS, president of the R. Thomas & Sons Company, East Liverpool, O., died in that place on April 20, at the age of 68 years.

THE CHASE CONSTRUCTION COMPANY, Detroit, although a new concern, is very busy with boat work, and will soon start the construction of the Lowell plant

THE ELECTRIC LIGHT PLANTS for the Schilling Corset Company, Union Trust Building and the Mabley Building, are among the model plants soon to be completed in Detroit.

THE DIAMOND ELECTRIC COMPANY on May 1 closed its Chicago office, and all business hereafter will be transacted direct with its main office, at 206 South Adams Street, Peoria, Ill.

THE MICHIGAN ELECTRIC COMPANY, Detroit, is equipping its new store, and will be moved about May 1. The store will be a model of completeness, and the best ever established in Detroit.

THE LAKON COMPANY, Elkhart, Ind., has recently received, through its New York office, an order for transformers to be shipped to Egypt. These will be carried overland about 350 miles by mule back transportation.

MR. J. F. OUTWATER, representing the H. Reisinger Electra Carbon, is making a short stay in Chicago, with headquarters at the Auditorium Hotel. Mr. Outwater has just returned from an extensive trip to the coast, and is now on his way East to attend the electrical convention.

THE CARD ELECTRIC COMPANY, Mansfield, O., have been awarded, by the Board of Managers of the Ohio State Reformatory, a contract for two direct-connected multipolar generators, capacity, 66 kilowatts each; speed, 250 revolutions per minute, to be connected to Ball engines.

THE WESTERN TELEPHONE CONSTRUCTION COMPANY, Chicago, Ill., have just closed a contract with the Ft. Wayne Telephone Company, Ft. Wayne, Ind., to furnish a two-thousand equipment, one thousand of which are to be shipped immediately. This will be the "Queen" independent telephone exchange system in America.

MR. E. P. ROBERTS, president of the Correspondence School of Technology, Cleveland, O., has been appointed consulting engineer for the electric lighting, power and steam heating, also for the hydraulic and sanitary engineering for the new Ohio State asylum for the insane, at Massillon, O. This institution, which is a very large one, is built on the cottage principle.

THE CONTRACT FOR THE CONDUIT SYSTEM AND ELECTRIC LIGHT WIRING for the new Government building at Detroit will doubtless be awarded very soon. Of course Detroit men are making an effort to secure the contract, and it is safe to say that if the work is done by Detroit contractors, and Detroit material is furnished, the work will be first class.

THE ELECTRIC APPLIANCE COMPANY states that it is well prepared for the fan motor season with a very complete line. It still retains the agency for the Meston line of alternating-current apparatus. The agency for the Dayton ceiling and column fan has been secured, and the new Acme fan motor, manufactured by the Appliance Company, will also be a specialty for this season. The latter is made in both single and three speed, and is a high-grade machine.

EUGENE MUNSELL & CO., importers and wholesale dealers in mica, 218 Water Street, New York, have opened a branch house at 153 Lake Street, Chicago, where they will carry a full assortment of all grades of mica for electrical insulation. The company's goods were formerly sold in Chicago, through W. H. Sills & Co., as sales agents. The business will be under the management of Mr. Chas. E. Coleman, who has been connected with the New York house for several years and is thoroughly familiar with the electrical trade.

THE TEXAS TELEPHONE SUPPLY & CONSTRUCTION COMPANY has just established State headquarters in Fort Worth, Tex. This company is the sole agent for the State of Texas of the D. A. Kusel Telephone Manufacturing Company, St. Louis, Mo. Messrs. C. A. Read and B. F. Holmes comprise the members of the first-named company, and they are enterprising business men, and are going to push the Kusel telephone in the big State. The D. A. Kusel Telephone Manufacturing Company is doing an excellent trade, and will move into larger quarters on May 1.

THE MICA INSULATOR COMPANY, manufacturers of the well-known insulation "Micanite," whose factories are at Schenectady, N. Y., and London, England, has opened a branch house at 153 Lake Street, Chicago, where it will carry a full line of "Micanite" plates, commutator rings and segments and slot insulations for all the standard railway motors and power generators, "Micanite" and empire cloth and paper. The company's goods were formerly sold in Chicago through W. H. Sills & Co., as sales agents. The business will be under the management of Mr. Charles E. Coleman, who has been connected with the New York house for several years, and is thoroughly familiar with the electrical trade.

THE STANDARD UNDERGROUND CABLE COMPANY, Pittsburg, Pa., is determined to place itself in a position where it can handle a contract for any character of installation with the least possible delay. For years it has been able to successfully undertake any contract for installing underground cables of high character, except conduits and rubber-covered wires and cables. Appreciating the importance of meeting every possible demand on the part of the electrical public, a large addition to its already extensive factories has been erected, and a complete modern plant for insulating wire and cables of all descriptions with rubber has been installed therein. This branch of the business has met with unexpected approval on the part of customers, and the high character of the product will undoubtedly steadily increase the output. The arrangements for testing the wires are particularly complete, and the care exercised in this department ensures the production of absolutely perfect insulation, or the discovery of any faults before the wire leaves the factory. The motto, "Rubber insulation with rubber in it," will appeal forcibly to those who have used many of the so-called "rubber" compounds. The very satisfactory results which may be attained by earnest and systematic efforts to improve the quality of the manufactured article is strikingly illustrated by the character of the cables furnished by the Standard Underground Cable Company at the present time for telephone use. A recent large order for the American Telephone & Telegraph Company, of Providence, was sold with a guarantee of 500 megohms per mile insulation resistance, and a capacity of .08 microfarads per mile. The tests of these cables by the electrician of the Providence Company disclose the remarkably low average capacity of .0743, and .0749 microfarads per mile. The highest capacity of any wire in the cable was .0776, and the lowest .0716, showing a high degree of uniformity. The insulation resistance of the wires averaged 1933 megohms, and 3300 megohms per mile in the shorter and longer cables respectively.

General News.

NEW INCORPORATIONS.

THE OREGON & FOREST CITY ELECTRIC RAILWAY COMPANY, Oregon, Mo., has been incorporated with a capital stock of $60,000.

THE JEFFERSON CITY LIGHT, HEAT & POWER COMPANY has been incorporated at Jefferson City, Mo., with a capital stock of $100,000.

THE J. B. GREENE ELECTRICAL COMPANY has been organized at Evansville, Ind. The capital stock is $5,000, and the incorporators are J. B. Greene, M. J. Bray, Jr., and S. W. Cook.

AVON ELECTRIC COMPANY, Avon, N. H., has been incorporated with a capital of $12,000. Directors: Cyrus Allen, Alva Carpenter, C. F. Whiting, L. H. Babcock, J. D. Carson and E. A. Nash, all of Avon.

THE FLEMINGTON ELECTRIC LIGHT, HEAT & POWER COMPANY, Flemington, N. J., has been organized by John Karr, Hackettstown, N. J.; Jacob Williamson and Furman R. Williamson, Flemington, N. J. The capital stock is $50,000.

THE GILLETTE LIGHT & POWER COMPANY, Gillette, Col., has been organized for the purpose of establishing and operating an electric light plant. The capital stock is $250,000, and the directors are Charles A. Smith, Thomas H. Smith, E. E. Smith and C. E. Smith.

THE MORSE SUPPLY COMPANY, Chicago, Ill., has been incorporated by B. C. Morse, William Horton and O. F. Hall, for the purpose of manufacturing and selling Morse's electric pulley covering, and also for the sale of other articles of merchandise. Capital stock, $1000.

THE CAMDEN SUBURBAN RAILWAY COMPANY has been organized at Camden, N. J., with a capital stock of $1,000,000. The incorporators are S. Frederick Hall, B. H. Chew and E. C. Leeds, of Camden; Frank R. Fithian, of Bridgeton, and Alonzo Barrett, of Haddonfield.

THE MONONGAHELA PASSENGER RAILWAY COMPANY, of Pittsburg, Pa., has been incorporated with a capital stock of $12,000, to build an electric passenger railway in Pittsburg. The incorporators are James D. Callery, John C. Reilly and Theo. A. Dierker, Pittsburg, Pa.

THE UNITED STATES CONDUIT COMPANY has been organized in Camden, N. J., to construct and lay underground conduits for electrical wires. The capital stock is $25,000, and the incorporators are Jacob E. Ridgway, Wm. S. Miller and Solomon S. Miller, all of Philadelphia.

THE AMERICAN ELECTRIC VEHICLE COMPANY has been incorporated in Chicago, Ill., with a capital stock of $250,000, to manufacture, sell and operate electric and other self-propelling vehicles. The names of the incorporators are F. S. Culver, W. W. Robinson and D. M. Carter.

THE NUNDA, OAKLAND & HUNTS TELEPHONE COMPANY, of Nunda, N. Y., was recently organized to build a telephone line between this place and Hunts. The officers are A. Y. Bennett, president; H. C. Farnum, secretary, and the directors are A. W. Chase, Frank Hewitt and Curtis Parker.

THE ELECTRIC STEAM HEATING COMPANY, of New England, has been organized in Paris, Me., to conduct a heating business in all its branches. Capital stock, $500,000. The incorporators are C. B. Bishop, of New York City; J. F. Wood, Boston, Mass.; and Fred J. Wood, of Snow's Falls, Me.

THE FARR TELEPHONE CONSTRUCTION & SUPPLY COMPANY has been organized in Chicago with a capital stock of $10,000. The incorporators are Kenneth R. Smoot, Clarendon B. Eyer and M. E. Shea. The company will manufacture, buy, sell and deal in telephones, electrical devices, appliances, supplies and machinery of every kind.

THE TOLEDO, BOWLING GREEN & FREMONT RAILWAY COMPANY has been incorporated at Toledo, O., for the purpose of building and operating an electric railway between Toledo and Fremont. The incorporators are Parks Foster, Thomas H. Walbridge, Dean V. R. Manley, John A. Moore, Edward D. Libbey and M. I. Wilcox. Capital stock, $500,000.

THE POSTAL TELEGRAPH CABLE COMPANY, OF MASSACHUSETTS, has been organized at Boston, Mass., for the purpose of constructing and operating lines of electric telegraph in highways and roads and across any water in Massachusetts. The incorporators are Herman J. Pettingill, Edward B. Pillsbury and Charles E. Bagley, Boston, Mass. Capital stock, $5000.

TELEGRAPH AND TELEPHONE.

OAK HARBOR, O.—Oak Harbor will have a telephone exchange.

LEWISTON, IA.—P. M. Davis is preparing to construct a telephone line between Lewiston and Lapwai.

MCCONNELLSBURG, PA.—A telephone line is to be built between McConnellsburg, Fort Littleton and other points in Fulton County.

PRINGHAR, IA.—There is a movement on foot to connect Pringhar by telephone with Sioux City, Sioux Falls and every town in O'Brien County.

LEAVENWORTH, KAN.—The Missouri & Kansas Telephone Company is extending its toll lines from this city to Holton, Horton and other points throughout Central Kansas.

MIDDLEBOROUGH, KY.—The Hustonville & Green River Telephone Line Company has let to Lexington parties for $500 the contract for putting up the wire from Hustonville to Dunville.

TUNKHANNOCK, PA.—Telephone lines are being erected between Mehoopany and Eatonville, to connect with the Eatonville & Tunkhannock Telephone Company's line. The lines will be extended to Lake Carey.

COUNCIL BLUFFS, IA.—An ordinance has been introduced in the City Council providing for the placing under ground before Dec. 1 next of all the telephone wires in certain prescribed districts of the city.

RYAN, IA.—Ryan is soon to have a telephone line, and perhaps two of them. Stock is already subscribed for a line to run from Coggon to Manchester, and the work will be commenced as soon as the frost is out of the ground.

GREENSBURG, PA.—The lines of the Bell Telephone Company were placed at the service of the Republican party free of expense on election day, April 8, last, for the purpose of getting returns from the primaries in this county.

PAINESVILLE, O.—The Painesville Telephone Company is now in practical operation, and has 141 instruments in use. The lines have been extended to Richmond and Perry, and they will be carried to other places in this locality.

REIDSVILLE, N. C.—The County Commissioners have granted R. J. Oliver, of Reidsville, permission to construct a telephone line from Reidsville as far as the Guilford line to Greensboro and from Reidsville to Leaksville and Spray.

Electric Light and Power.

SCHOOLCRAFT, MICH.—At a meeting of the Village Council, Messrs. Rheubottom & Bond, of Union City, were granted a 15-year franchise for an electric lighting and power plant.

MADISON, WIS.—The Madison City Council has instructed Frank B. Rae, of Chicago, to draft plans and specifications for an electric lighting plant for the city. It is estimated the plant will cost $24,000.

ROCHESTER, N. Y.—At a meeting of the Board of Supervisors the Building Committee will present a report recommending the establishment of an independent electric lighting plant for the new Custom House.

THE CRESTED BUTTE LIGHT & POWER COMPANY'S plant, which was shut down recently because of the scarcity of water in the reservoir, is again in operation. The town authorities have heretofore considered it safer to suffer from darkness than incur the danger of a fire with an exhausted reservoir.

BALTIMORE, MD.—The Edison Electric Light Company tried to secure permission to build its own system of subways for its wires, but Mayor Hooper has refused to grant the desired consent, on the ground that the city proposes to build a general system of subways, which the Edison Company can use in common with other companies.

NIAGARA FALLS, ONT.—The Canadian General Electric Company, of Peterboro, Ont., has secured the contract for the electric light plant at this place. Other bidders were the Royal Electric Company, of Toronto; the Westinghouse Electric & Manufacturing Company, of Pittsburg, and the Fort Wayne Electric Corporation, of Fort Wayne, Ind.

BROOKLYN, N. Y.—At a meeting of the Board of Aldermen the report authorizing 1000 more electric street lights for this year was passed upon favorably. The Edison contract, which is favored by the Committee on Gas and Electricity, provides for the reduction of 1 cent a night if 400 lamps are used, but if the number of lights is reduced there will be an increase of 5 cents.

MIDDLETOWN, N. Y.—Some well-known gentlemen of this place are considering the matter of organizing a new electric light company. It is not their intention to buy the present plant, but if the company is formed, entirely new machinery of the latest designs will be installed, so as to reduce the cost of operation to a minimum. If the new company is organized, it will furnish only arc lights for the streets.

T. S. TALLIAFERRO has until recently been Mayor of Green River, Wyo., as well as president of the new electric light company in that place. A short time ago he resigned the mayoralty in order to enter into a contract with the municipality for electric lighting. His proposition was accepted, and the company has signed the agreement to light the city for two years. The service will commence on May 1.

HARRISON, N. J.—A writ of certiorari has been granted to the Excelsior Electric Light Company of Harrison against the Common Council of Harrison and the Newark Electric Light & Power Company of Newark. The Excelsior Company, which is now lighting the streets of Harrison, claims that its contract, which is yet to run for three years, has been ignored by the City Council, and another entered into with the Newark Electric Light & Power Company.

The Electric Railway.

HAGERSTOWN, MD.—The Hagerstown Electric Railway will be extended to Williamsport.

WHITE PLAINS, N. Y.—It is probable that the trolley road from White Plains to Mamaroneck will be built at once.

BUFFALO, N. Y.—A system of railway mail service will be introduced on the lines of the Buffalo Railway Company.

SARATOGA, N. Y.—It is rumored that the Union Electric Railway and the Mount Gregor road will be exended to Ballston Spa.

OTTUMWA, IA.—The Ottumwa Electric Railway, Light, Power & Steam Company has passed into the hands of J. H. Merritt, as receiver.

BALTIMORE, MD.—The measure empowering the Traction Company to construct railway lines from Preston Street and Fremont Avenue and other streets to Liberty Road is being considered.

NEW ORLEANS, LA.—The Canal & Claiborne Street Railway Company has completed arrangements for the location of its power-house on the river front. Specifications are now being sent out for bids.

AUGUSTA, ME.—It is understood that a petition will shortly be circulated through the city asking that the Augusta, Hallowell & Gardner Electric Railway run a branch across the bridge to the east side.

FORT LEE, N. J.—At a special meeting of the Township Committee a franchise was granted the Bergen County Traction Company to construct and operate a trolley road through the village of Nordhoff.

WINONA, MINN.—The Winona General Electric Company's plant and the Winona City Railway Company's plant have been sold to Frank A. Seymour; $170,000 being paid for the former and $100,000 for the latter.

RED BANK, N. J.—The Town Commissioners have granted a franchise to the Atlantic Highlands, Red Bank & Long Branch Electric Railway Company, to operate a trolley line in Monmouth, Front and Broad Streets and Wharf Avenue.

TONAWANDA, N. Y.—The boiler of the Buffalo, Kenmore & Tonawanda Electric Railway Company exploded last week, causing damage that will delay the traffic on the road two weeks. Fortunately no one was injured.

LEWISTON, ME.—The Lewiston & Brunswick Street Railway Company has been incorporated by N. Q. Pope, F. V. Dana, Henry W. True, Wm. T. Smart, and Orlando Ham. The length of the road is to be 21 miles and the capital $200,000.

PORTLAND, ME.—The work of laying the track of the Portland Railway Company in this city will be resumed. Double tracks will be laid on some streets and the lines already laid will be reconstructed. The Stroudwater line will also be laid with heavier rails.

WHITE PLAINS.—The New York, Elmsford & White Plains Railway Company has accepted the franchise awarded it by the Tarrytown Village Trustees, to run between the two villages, and soon will begin work to extend its tracks from Elmsford to Tarrytown.

HOBOKEN, N. J.—The Hoboken Common Council at its meeting granted the Jersey City, Hoboken & Rutherford Electric Railway a franchise to run its cars through First Street to the Post Office. The company was also granted permission to operate a stage line through the street until the tracks were laid.

TARRYTOWN, N. Y.—Several members of the North Tarrytown Good Government Club talk of forming a stock company for the purpose of building a trolley road between North Tarrytown and Elmsford, the route to pass through the village of Pocantico Hills, Pleasantville, Sherman Park, Unionville and East View.

DAYTON, O.—The Troy, Tippecanoe & Dayton Electric Railway Company is the latest applicant for right of way through Montgomery County. The proposed route in this county is over the Miami and Montgomery Pike through the towns of Vandalia and Chambersburg, to the bridge crossing the Miami River at Webster Street.

OSHKOSH, WIS.—A franchise has been granted the Oshkosh, Berlin & Omro Railway Company to build an electric passenger and traffic line between this city and Berlin by way of Omro, a distance of about 40 miles. Under the terms of the franchise work must be begun in four months, and the road must be in operation by January, 1897.

BOSTON, MASS.—The Massachusetts Street Railway Association held its monthly dinner at Young's Hotel on the night of April 8. There were 25 members present and President Prentiss Cummins occupied the chair. The topic of discussion was "The Transmission of Power" and was opened by J. C. Winchester, of Melbourne, Australia.

NEW YORK, N. Y.—The Board of Aldermen have, in response to Mayor Strong's request, passed over his veto the three resolutions granting extensions to the Metropolitan Traction Company in University Place, Third and Fourth Streets, Dey and Greenwich Streets, West Broadway and Broome Street from Crosby to Broadway.

Trade and Industrial Notes.

THE PAYNE ENGINE COMPANY, Elmira, N. Y., is to exhibit its improved governor at the Electrical Exposition.

THE WILLIAMSPORT WOODEN PIPE COMPANY expects to have an attractive exhibit of wooden conduit at the Electrical Exposition.

THE KNOWLES STEAM PUMP WORKS, 93 Liberty Street, New York, has just issued a special illustrated catalogue of its electrically operated steam pumps.

THE ORIENT ELECTRIC COMPANY, of Youngstown, O., is now making a specialty of Crookes tubes to supply the demand for this now very important article of trade.

THE AMERICAN ELECTRIC HEATING CORPORATION, Boston, Mass., has just issued a special pamphlet in which the features of electric heating and cooking are set forth.

THE BRADFORD BELTING COMPANY, Cincinnati, O., has brought out some special devices, including an insulating lamp-hanger, safety-lamp support and improved pole padlock.

THE CLEVELAND TWIST DRILL COMPANY, Cleveland, O., has added some new things to the list in its catalogue. These include bell hangers and electricians' bits, which are made in 16 sizes.

THE TUCKER ELECTRICAL CONSTRUCTION COMPANY, 14 Whitehall Street, New York, in its new catalogue No. 3, on the Auto-Telephone System, gives the prices of its latest telephone apparatus.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, Chicago, has issued a new catalogue on magnets and extension bells, receivers, induction coils, back boards, and various telephone devices.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., had its factory destroyed by fire on Monday, April 20. It has procured a new factory and will resume business at once, and will be ready to fill all orders by the latter part of the week.

THE HOPPES MANUFACTURING COMPANY, Springfield, O., in a well-illustrated catalogue describes the Hoppes line-steam feed-water purifiers and exhaust steam feed-water heaters. A long list is given of the names of users of these feed-water heaters.

JOSEPH DIXON CRUCIBLE COMPANY.—At the annual meeting of the stockholders of the Joseph Dixon Crucible Company, held at the company's main offices on Monday, April 20, the old board was re-elected by an almost unanimous vote, and the present officers were re-elected by the directors.

THE WARREN ALTERNATOR, of the Warren Electric Company, Chicago, is well described and illustrated in a little pamphlet. The company is represented in New York by Wendell & MacDuffie, at 26 Cortlandt Street.

THE FERRACUTE MACHINE COMPANY, of Bridgeton, N. J., manufacturers of presses and dies and other sheet metal tools, makes a number of presses which are especially adapted for the electrical trade. Among others the company builds a number of open front presses for cutting armature discs up to 20 inches in diameter; also a large number of round and square bed double-crank presses, the bed being placed between two columns. This style press seems to have proved very popular, the General Electric Company having seven of them in use, while many others are using them for electrical work. The Ferracute Machine Company also makes an improved indexing machine for notching armature discs of various sizes, from 3 to 36 inches diameter. This is arranged with adjustable sliding head and with changeable index plates, so that various numbers of teeth can be made in any size of disc. They are provided with a chuck and set of dies for any desired style of notch. The company also makes a number of sizes of its punching pressess for cutting out instrument work and other goods in heavy metals, which have proved popular in the electrical trade. It expects to exhibit three or four presses at the Electrical Exposition in New York in May, and will probably have them running with an electrical motor, and manufacture a small article.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED APRIL 21, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

558,480. APPARATUS FOR ELECTRICALLY WORKING AND WELDING COPPER; G. D. Burton, Boston, Mass. App. filed Aug. 11, 1893. The combination in an electrical heating apparatus, of conductors connected to a converter, electrodes arranged to bear upon the bar to be heated, metal electric conducting blocks mounted on insulating sliding supports arranged to move toward and from the electrodes to clamp the bar to be heated between the contact surfaces of the latter and those of said blocks, and a lever arranged to operate upon said sliding supports to clamp and unclamp said blocks.

558,491. ELECTRIC STREET-CAR MOTOR; S. Harris, Cleveland, O. App. filed Feb. 10, 1896. An electric street-car motor having each of its field coils separately detachable with its core from the motor body, and the body separable in the plane of the armature shaft. (See Illustration)

558,506. PRINTING TELEGRAPH; B. F. Merritt, Newark, N. J. and J. M. Joy, New York, N. Y. App. filed June 29, 1895. In a printing telegraph receiver, a carriage provided with rollers, a track for the rollers, a retracting device for moving the carriage in one direction, a worm-wheel pivoted in and supported by the carriage, a shaft passing through the worm-wheel and connected to the same by a spline and groove, a type-wheel also pivoted in and supported by the carriage, a shaft passing through the type-wheel and connected to the same by a spline and groove, a motor adapted to rotate both shafts, a rack adapted to be moved toward and from the worm-wheel, and means to move the rack to allow the carriage to be moved by the said retracting device.

558,507. AUTOMATIC GOVERNING DEVICE FOR MOTORS; B. F. Merritt, Newark, N. J., and J. M. Joy, New York, N. Y. App. filed June 29, 1894. The combination with an electric motor, a train of gearing, and a shaft to be driven, of a worm mounted upon and secured to one of the shafts of the gearing, a lever having its free end universally movable, a point carried on its free end to engage the worm, a circuit-maker and breaker in the path of the lever and connected to the terminals of the motor circuit, a spring connected to the lever, a shaft for said lever, and an arm secured to the shaft; a pin carried by a disc secured to one of the shafts, to engage the arm and means to start the rotation of the shaft.

558,509. WIRE-CLAMP FOR TELEGRAPH OR SIMILAR WIRES; G. Middleton, Kirkwood, N. J. App. filed July 31, 1895. A clamp for telegraph and similar wires comprising a wire bail of sufficient size to loosely slip over an ordinary annularly-grooved insulator, said bail being made of a single length of wire and provided with a straight transverse wire connecting the opposite portions thereof at one end, said opposite side portions of the bail being bent at their points of connection with the tranverse wire to form engaging hooks adapted to engage over a line-wire and hold such wire in the groove of the insulator without a crimping or bending of the wire, the side portions of the bail adjacent to said hooks being further provided with short inclined portions and a straight cam-lever provided at one end with a perforated cam-head loosely mounted on the rounded end of the bail, and adapted to have its nose engage beneath the ridge of the insulator below the plane of the groove in which the line wire is held, whereby the bail will be drawn in a downward direction to lock itself and the line wire on the insulator.

558,517. REGULATOR FOR ELECTRIC MOTORS; O. H. Pieper, Rochester, N. Y. App. filed Jan. 20, 1896. The combination with a shunt-wound motor of a variable resistance capable of variation when the motor in running connected across between one wire or conductor of the field, and the corresponding wire or conductor of the armature.

558,518. HANDLE FOR CIRCUIT-BREAKERS; W. B. Potter, Schenectady, N. Y. App. filed Jan. 15, 1896. A plurality of automatic circuit-breakers, and an interchangeable handle therefor, removable only when the circuit is open.

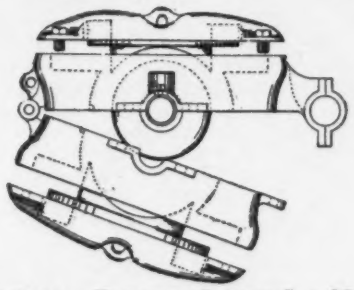
558,539. CORE FOR ELECTROMAGNETS; A. G. Waterhouse, Hartford, Conn. App. filed Oct. 16, 1894. A curved or bent core for electromagnets composed of one or more turns of parallel members, each consisting of a thin iron bar or strip, rolled or compressed at its outer edge or periphery, and thereby formed to the curve of the core for the finished magnet.

558,555. ELECTRIC GUEST CALL; S. G. Gimbel, Vincennes, Ind. App. filed Dec. 12, 1895. In a guest call apparatus, the combination of a plurality of switchboards adapted to be placed in guest apartments, and respectively comprising a conductive bar and a series of conductive plates separated from said bar, electrical alarms, also placed in the guest apartments, a series of push buttons adapted to be placed in a hotel office, electrical connections between the conductive plates of the several switchboards and the push buttons, electrical connections between the bars of the several switchboards and the electrical alarms, a battery, electrical connections between one of the poles of said battery and the push buttons, conductors connecting the electrical alarms and the outer pole of the battery, means for closing the breaks between the conductive bars and the plates of the several switchboards, a push button, a conductor connecting one of the conductive plates of said button, and the battery and conductors connecting the other conductive plate of the said push button, and the bars of the several switchboards.

558,559. ELECTRIC RHEOSTAT OR HEATER; H. W. Leonard, East Orange, N. J. App. filed Dec. 18, 1895. The combination of a conductor, a supporting body, and a layer of insulating material between the same, and in which the conductor is partially embedded, and which attaches the conductor to the supporting body.

558,564. ELECTRIC ALARM SYSTEM; C. A. Rolfe, Chicago, Ill. App. filed Sept. 24, 1894. In an alarm system comprising signal transmitting mechanism connected with the main line, and an auxiliary or home circuit for operating said signal-transmitting mechanism, provided with a bridge, and an alarm operated by a current crossing the bridge.

558,565. RAILWAY SIGNAL; W. G. Roome, Jersey City, N. J. App. filed Nov. 17, 1893. In a railway signal system, the combination of a dynamo, a distribution system extending therefrom, transformers having the primary circuits connected to the distribution system, the secondary circuits being connected to the tracks of the block, and track circuit relays arranged to control the signals of the system.



No. 558,491.—ELECTRIC STREET-CAR MOTOR.

558,566. RAILWAY SIGNAL; W. G. Roome, Jersey City, N. J. App. filed Nov. 17, 1893. In a railway signal system comprising a number of sections, the combination of a number of signals in said sections, a common source of electricity supplying said signals, means for conveying a part of the electricity from said common source to a moving train to operate a signal on the train and a track circuit controlling the train signal.

558,573. APPARATUS FOR DETACHING ELECTRIC LAMP BULBS; O. Smith, Detroit, Mich. App. filed Oct. 7, 1895. In a lamp detacher, a flexible shaft provided with means for engaging the lamp, and means for rotating said shaft.

558,584. TELEPHONE; S. D. Field, Stockbridge, Mass. App. filed Aug. 24, 1895. In a a telephone, the combination with the diaphragm, magnet coil, and core thereof, of a closed conducting circuit surrounding the core.

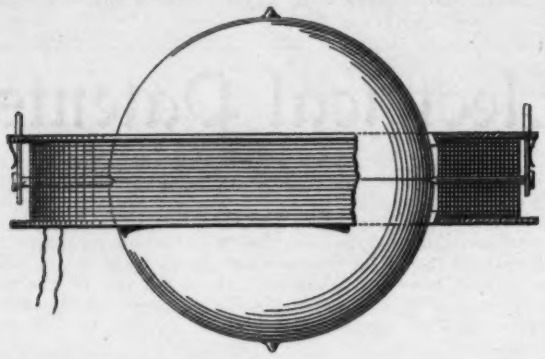
558,585. ELECTRIC METERING SYSTEM; J. W. Gibboney, Lynn, Mass. App. filed March 6, 1895. The combination with a system of electric meters individually connected with their respective supply mains, and adapted to operate successively or simultaneously, of a summation-register adapted to separately add the units of such meters after each unit is recorded, and means intermediate of the meters and summation-register for actuating the latter consecutively after the operation of each of said meters.

558,602. ELECTRIC SIGNAL FOR RAILWAY TRAINS; E. J. Devine, Schreiber, Can. App. filed July 25, 1895. In a train signal having a series of wires in each car, a coupling for said wires between said cars composed of two parts or members having interlocking U-shaped plates to which said wires are connected, and short circuit-closers carried by said parts or members, and having contact portions divided into members designed to fit snug between U-shaped plates when said parts or members are separated.

558,607. DROP-LIGHT ELECTROLIER; G. Peeples, Philadelphia, Pa. App. filed Dec. 24, 1894. The combination with rigid guide bars, of the exten-

sible lamp-carrying tube, wires therein extending from the lamp, a block carried by the upper end of said tube, discs on said block having openings for the rigid guide-rods and spring-pressed blocks in contact with the guide-rods and electrically connected to the lamp wires.

558,617. TELEGRAPH KEY; W. E. Simons, Dublin, Can. App. filed Sept. 12, 1895. The combination with a telegraph key, provided with an operating-lever and a front contact-point, of a spring circuit-closer connected with the front contact-point, and bearing downward on said lever, a trip lever pivoted to the operating lever, and having its rear end pivoted to and insulated from the free end of the circuit closer, and a spring connected to the rear end of the operating lever, and operating to prevent it from rising until the circuit closer has been moved out of contact with it.



No. 558,634.—Electric Glow-Lamp.

558.634. ELECTRIC GLOW LAMP; E. A. Colby, Newark, N. J. App. filed May 21, 1894. The combination in an electric glow lamp of an induction coil, a receiver within said coil and within said lever, and surrounded by said coil, a closed conductor in flat circular form having its face disposed in a plane parallel to the face of the coil. (See Illustration.)

558,650. MEANS FOR CONTROLLING ELECTRIC CURRENTS; P. Kennedy, Brooklyn, N. Y. App. filed June 27, 1895. In combination with a main circuit, an electrical generator adapted to supply current thereto, a circuit of control adapted to govern said generator, and comprising a branch in circuit, through resistances of unequal strength with a series of conductors, one extremity of each of which conductors is situated within a movable vessel containing conducting fluid, said extremities being situated at different levels, with which fluid the other branch of the circuit of control is in circuit, an electromagnetic device included in the main circuit and operated by its current, and suitable mechanical connections between said electromagnetic device and said vessel, by which movement of the former is transmitted to the latter.

558,672. RELAY; F. E. Chapman, Medford, Mass. App. filed Jan. 27, 1896. A relay comprising in its construction an induction coil having windings in inductive relations, an armature, means whereby said armature is magnetized by one of the windings of said coil and means whereby said armature is operated by the other winding of said coil.

558,686. TELEPHONE TRUNK CIRCUIT; W. H. Hennessey, Chicago, Ill. App. filed Feb. 7, 1896. A combined conversation and signalling circuit, the former consisting of inductively-connected sections with means at each end section for connection with sub-station circuits, and also for controlling the signalling-circuit, the signalling-circuit having two lamp-signals at the called end adapted to be successively lighted from the calling end and to be extinguished from the called end, which circuit consists of the two conductors of the central section of the conversation-circuit combined with circuits at each end thereof, the circuit at the calling end being normally held open by the relay there and the circuit at the calling end closed through a lamp-signal, a plug-seat switch, and a source of current, and also through the second lamp-signal and the said source of current.

558,687. APPARATUS FOR OPERATING ELECTRIC SWITCHES; D. Hinchliffe and A. D. Edes, Plymouth, Mass. App. filed May 15, 1895. In combination with an electric switch, an electromagnet, an armature having a catch to hold the pole or poles of the switch in circuit, a fulcrumed handle, the lower end of which is adapted to operate upon a cam-shaped projection on the top of the armature, and connections between said electric magnet and a series of push buttons, whereby said switch can be released by drawing the handle forward or by depressing either of the push buttons.

558,692. METHOD OF MANUFACTURING ELECTRODES FOR SECONDARY BATTERIES; I. Kitsee, Philadelphia, Pa. App. filed Nov. 8, 1894. The method of constructing an electrode for secondary cells, which consists in subjecting conducting material in its raw and unfinished state to the action of the current in an electrolytic bath, then subjecting the material to the action of heat, and finally shaping it into the required form of the electrode.

558,714. ELECTRIC HEATING; C. S. Bradley, Avon, N. Y. App. filed Aug. 22, 1891. A system of electric heating, comprising a heater and regenerator containing a resistance to be heated by an electric current, a conduit for leading the fresh air to the heater, a pipe for discharging it into an apartment, a pipe for discharging the air from the apartment over the walls of the conduit, an electric motor and two blowers communicating with the induction and eduction pipes, respectively.

558,727. ELECTRIC STAND LAMP; R. Graves, Irvington, N. Y. App. filed Feb. 25, 1896. In an electric light or candelabra, the combination of a standard or support, a tubular casing mounted in the upper end thereof, a tube passing through said casing, an incandescent electric light bulb mounted in said tube, conductors which are connected with binding posts in the bottom of said standard or support, and which extend upwardly therethrough, and which are connected with binding posts at the upper end of said tube, and means for making electrical connection with said conductors.

558,741. TROLLEY; J. H. Rabbitt, Wethersfield, Conn. App. filed Oct. 10, 1895. An electric trolley consisting of a spring-actuated pole, a bar which is centrally pivoted to the free end of said pole, and two contact wheels which are respectively pivoted to the opposite ends of said bar, and are pressed towards the trolley wire by the action of said spring-actuated pole, in combination with a spring which is located between said pole and said bar, and assists the said action of said spring-actuated pole as to one of said contact wheels, and opposes the said action of said pole as to the other of said wheels.

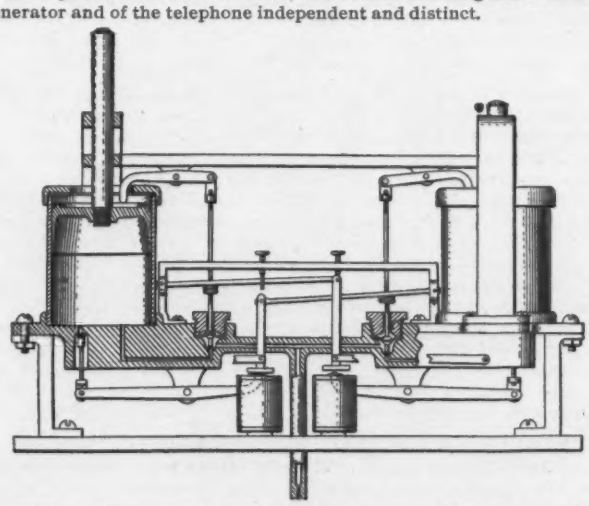
558,749. ELECTRICALLY-CONTROLLED GAS ENGINE OR MOTOR; G. L. Thomas, Montclair, N. J. App. filed Nov. 11, 1895. In a motor adapted to be operated by compressed gas, the combination of a cylinder and a piston therein, an inlet valve held to its seat by an electromagnet, and opened by the pressure of the gas when the magnet is de-energized, and an outlet valve controlled by an electromagnet. (See Illustration.)

558,750. MULTIPLE CONTACT SWITCH; E. H. Wright, Chicago, Ill. App. filed Nov. 28, 1894. A three-wire system switch comprising a switchboard provided with two sets of terminals, each of which sets of terminals embraces three binding screws or connecting devices, a plurality of contact points on said switchboard, arranged in three electrically-connected groups, each of which groups is electrically connected with one of the terminals of one of said sets, and a movable member provided with a plurality of contact points, each electrically connected with one of the terminals of the other set of the switchboard, the contact points of the movable member being adapted for various engagement with those of the switchboard.

558,758. FASTENING INSULATOR BRACKETS; L. S. Beardsley, Naugatuck, Conn. App. filed Oct. 30, 1895. An insulated holder or pin, consisting of a main portion having its upper end screw-threaded for the reception of the insulator-hood, and its lower end formed with lugs.

558,858. RAILWAY BLOCK SIGNAL; F. C. Stevens and J. Donovan, Lowell, Mass. App. filed Aug. 20, 1895. In a railway block signal, the combination of signal-setting devices adapted to be positively actuated by a passing train to set the semaphore at "danger," and comprising a crank shaft, a weighted wheel fast thereon, a locking pawl for said wheel, a wheel weighted in a less degree than the before-mentioned wheel, and loose on said shaft, and adapted to lift said pawl, devices connected to the crank-shaft whereby it is actuated by a passing train, and an electric lock for the loosely-mounted wheel which is adapted to release the same when the train passes from the block and thus releases the other weighted wheel, and allow the semaphore to return to "safety."

558,859. TELEPHONE APPARATUS; A. Stromberg and A. Carlson, Chicago, Ill. App. filed Oct. 9, 1894. The combination with permanent bar magnets, of pole-pieces mounted upon the end of said magnets, between which the armature is adapted to rotate, soft iron cores extending from the ends of said magnets opposite those upon which said pole-pieces are mounted, the ends of said cores lying in proximity and carrying telephone-coils, a diaphragm mounted opposite the ends of said cores, and a bar of magnetic material connecting the middle portions of said permanent bar magnets to afford a path for the lines of force, and render the magnetic fields of the generator and of the telephone independent and distinct.



No. 558,749.—Electrically Controlled Gas Engine or Motor.

558,868. MEANS FOR RELEASING TROLLEY-POLE SUPPORTS; H. P. Wellman, Ashland, Ky. App. filed Sept. 17, 1895. The combination with a pivotally-mounted trolley-pole base, of a device for turning said base, a pivoted frame supporting said device, and a compressed air cylinder having its piston rod connected to said device.

558,869. TROLLEY FOR ELECTRIC RAILWAY CARS; H. P. Wellman, Ashland, Ky. App. filed Oct. 1, 1895. The combination with an electric railway car having a pivoted overhead trolley pole, a pneumatic device for engaging said trolley pole, and automatically effecting the lowering of the outer end thereof in the event of a trolley wheel jumping off the wire.

558,870. ELECTRIC RAILWAY CAR; H. P. Wellman, Ashland, Ky. App. filed Nov. 5, 1895. The combination with an electric railway car, of a revoluble trolley pole base having passage ways therein, a pneumatic pressure device carried by said base for automatically moving said pole, and pipe connections opening into said device and leading from said passageways in said base.